

Комиссия по наблюдениям, инфраструктуре и информационным системам

Сокращенный окончательный отчет третьей сессии

Женева

15–19 апреля 2024 года



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МЕТЕОРОЛОГИЧЕСКАЯ
ОРГАНИЗАЦИЯ

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ВМО-№ 1353

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Разделы «Общие соображения» резолюций, принятых на сессии, а также информационные документы (INF), упомянутые в настоящем отчете сессии, и любые представленные на сессии дополнительные материалы можно найти на [странице отчета сессии](#) в электронной библиотеке ВМО.

ОБЩЕЕ РЕЗЮМЕ РАБОТЫ СЕССИИ

1. Президент Комиссии по наблюдениям, инфраструктуре и информационным системам (ИНФКОМ), г-н Мишель Жан, открыл третью сессию Комиссии в понедельник, 15 апреля 2024 года, в 09:00 по центральноевропейскому летнему времени и приветствовал участников.
2. Генеральный секретарь профессор Селеста Сауло также приветствовала делегатов сессии и заявила, что метеорологическая и гидрологическая инфраструктура является опорой для формирования ценности, которая столь необходима для предоставления основного обслуживания в области погоды и климата. Она отметила достижения Членов и экспертных групп, работающих над развитием глобальных общественных благ, и уделила особое внимание проблемам изменения климата и удовлетворению потребностей развивающихся стран. Генеральный секретарь особо отметила модель Глобальной опорной сети наблюдений (ГОСН), которая позволяет выявлять потребности и пробелы, а также Фонд финансирования систематических наблюдений (ФФСН), который позволяет развивающимся странам ликвидировать данные пробелы в наблюдениях. Она отметила поддержку ФФСН со стороны доноров, но подчеркнула необходимость дополнительного финансирования. Помимо этого, Генеральный секретарь рассказала о таких инициативах, как ИСВ 2.0, Единая политика ВМО в области данных, а также о флагманских инициативах «Заблаговременные предупреждения для всех» (ЗПДВ) и «Глобальная служба наблюдения за парниковыми газами» (ГСНПГ), подчеркнув их роль в активном противодействии изменению климата и обеспечению устойчивого будущего. Генеральный секретарь настоятельно призвала к всеобщей приверженности продвижению этих инициатив и поблагодарила Секретариат за усилия, завершив свое выступление пожеланием плодотворной работы.
3. Заместитель Генерального секретаря г-жа Ко Барретт выразила готовность перенять опыт работы сессии Комиссии. Она обратила внимание на ключевые области возможностей, сделав акцент на системе Земля в рамках расширенной программы Всемирной службы погоды и ГСНПГ. Заместитель Генерального секретаря подчеркнула важность решения проблемы изменений в Арктике, особенно деградации многолетней мерзлоты, так как этот процесс влечет за собой серьезные последствия для уровня углерода и потепления климата, и высоко оценила развитие передовой практики в области ее измерения. Она также подчеркнула, что Глобальная система наблюдений за климатом (ГСНК) играет важнейшую роль в предоставлении климатической информации, которая может помочь в деле заблаговременного обнаружения критических переломных моментов. В заключение заместитель поблагодарила Членов за поддержку и выразила уверенность в успехе предстоящих обсуждений.
4. Комиссия приняла к сведению, что в соответствии с решением президента, принятым по согласованию с Генеральным секретарем и объявленным в циркулярном письме 04363/2024/CSG/INFCOM-3 Elections от 2 апреля 2024 года, в ходе сессии применялся режим дистанционного участия.
5. Комиссия утвердила повестку дня, приведенную в [приложении 1](#).
6. Комиссия учредила следующие комитеты:
 - 1) Комитет по проверке полномочий:
Председатель: Намибия
Члены: главный делегат от Тринидада и Тобаго
 - 2) Комитет по назначениям:
Председатель: Индонезия

Члены: главные делегаты Малайзии и Швейцарии

3) Координационный комитет:

Председатель: президент ИНФКОМ

Члены: вице-президенты ИНФКОМ, заместитель Генерального секретаря, председатели постоянных комитетов, директор Департамента инфраструктур, секретари пленарных заседаний, назначаемые Генеральным секретарем, и сотрудник по конференционному обслуживанию.

7. Комиссия согласовала предложенную президентом процедуру избрания председателей и вице-председателей вспомогательных органов: после избрания должностных лиц избранные должностные лица рассмотрят список кандидатов, подготовленный Секретариатом на основе предложений Членов, и предложат список для рассмотрения и утверждения Комиссии.

8. Комиссия согласовала программу работы сессии и время работы заседаний: с 09:00 до 12:00 и с 14:00 до 17:00 по центральноевропейскому летнему времени. Она также приняла к сведению [правило 95](#) Общего регламента (*Сборник основных документов № 1* (ВМО-№ 15)), касающееся записей и протоколов сессии.

9. Комиссия приняла к сведению доклад президента Комиссии, включая доклады председателей вспомогательных органов, где освещалась работа, проделанная за период после второй сессии.

10. В начале общей дискуссии президент напомнил, что Комиссия является техническим и научным органом, и поэтому дискуссия должна касаться технических вопросов. Он предложил высказать свои замечания по докладу президента и предложенному плану работы, а также предложил высказать предложения по приоритетам, которые могли бы способствовать работе Комиссии, в частности по пунктам 5 и 6 повестки дня («Рассмотрение относящихся к Комиссии программ ВМО, включая стратегическое планирование»).

11. Делегат от Украины рассказал о проблемах, с которыми сталкивается Национальная метеорологическая и гидрологическая служба Украины в связи с разрушением инфраструктуры, что приводит к снижению доступности гидрометеорологических данных для международного обмена и препятствует глобальным усилиям по обеспечению готовности к бедствиям и мониторингу климата. Он заявил о готовности ученых и специалистов его страны продолжать предоставлять данные и информацию международному сообществу и выразил благодарность Финляндии, Литве и Румынии за поддержку, оказанную для обеспечения бесперебойной работы.

12. Соединенные Штаты Америки выступили с заявлением о поддержке выступления украинской делегации, касающегося последствий для инфраструктуры.

13. Российская Федерация, Южная Африка и Китай поддержали комментарий президента о том, что Комиссия является площадкой для обсуждения исключительно технических и научных вопросов.

14. Нигер приветствовал призыв о международной поддержке наблюдений в кризисных зонах и напомнил, что другие страны сталкиваются с трудностями с предоставлением наблюдений и обеспечением функционирования по различным причинам.

15. Президент подчеркнул необходимость сохранения характера Комиссии как площадки для обсуждения технических вопросов, которая способствует развитию сотрудничества, и отметил важность международной поддержки для восстановления национальных инфраструктур в кризисных зонах.
16. На сессии было принято 12 резолюций, которые приводятся в [приложении 2](#).
17. На сессии было принято 34 решения, которые приводятся в [приложении 3](#).
18. На сессии было принято 13 рекомендаций Исполнительному совету, которые приводятся в [приложении 4](#).
19. Комиссия рекомендовала Исполнительному совету обратиться к Генеральному секретарю с просьбой опубликовать, в соответствии с [резолюцией 47 \(Кг-19\)](#) «Обязательные публикации ВМО и политика в области распространения на девятнадцатый финансовый период», и предложить Членам использовать следующие руководства и руководящие принципы, принятые сессией:
- (1) [Руководство по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1165), принятое в рамках [резолюции 4 \(ИНФКОМ-3\)](#);
 - (2) [Технические руководящие принципы для региональных центров ИГСНВ по системе мониторинга качества данных ИГСНВ](#) (ВМО-№ 1224), принятые в рамках [резолюции 5 \(ИНФКОМ-3\)](#);
 - (3) [Руководящие принципы по наилучшим практикам обеспечения готовности пользователей к использованию метеорологических спутников нового поколения](#) (ВМО-№ 1187), принятые в рамках [резолюции 6 \(ИНФКОМ-3\)](#);
 - (4) [Руководство по приборам и методам наблюдений](#) (ВМО-№ 8), включая Руководящие принципы проведения взаимосравнений радиометров, принятые в рамках [резолюции 7 \(ИНФКОМ-3\)](#) и [решения 13 \(ИНФКОМ-3\)](#);
 - (5) [Guide to Operational Weather Radar Best Practices](#) (Руководство по передовой практике использования оперативных метеорологических радиолокаторов) (ВМО-№. 1257), принятое в рамках [резолюции 8 \(ИНФКОМ-3\)](#);
 - (6) [Руководство по гидрологической практике, том I](#) (ВМО-№ 168), принятое в рамках [резолюции 9 \(ИНФКОМ-3\)](#);
 - (7) [Руководство по Информационной системе ВМО](#) (ВМО-№ 1061), принятое в рамках [резолюции 10 \(ИНФКОМ-3\)](#);
 - (8) [Climate Data Management System Specifications](#) (Спецификации Системы управления климатическими данными) (ВМО-№. 1131), принятые в рамках [резолюции 11 \(ИНФКОМ-3\)](#);
 - (9) [Guide to the WMO Integrated Processing and Prediction System](#) (Руководство по Интегрированной системе обработки данных и прогнозирования ВМО) (ВМО-№. 305), принятое в рамках [решения 18 \(ИНФКОМ-3\)](#).
20. Список участников приводится в [приложении 5](#). Из общего числа 435 участников 152 были женщины, что составило 35 %, и 283 — мужчины, что составило 65 %.
21. Перед закрытием заседания президент Комиссии пригласил г-на Нира Става, директора Департамента инфраструктур Секретариата, который от имени Генерального секретаря обратился к участникам заседания и выразил свои искренние поздравления в

связи с выдающимися достижениями сессии и поблагодарил Членов и экспертов за их вклад. Он выразил надежду, что в состав вспомогательных органов, которые Комиссия учредит после сессии под руководством вновь избранных должностных лиц, войдут эксперты с различными компетенциями, опытом, а также разнообразного гендерного и регионального представительства.

22. В своем заключительном слове г-н Жан выразил признательность техническим экспертам за их вклад в достижение выдающихся результатов в ходе сессии и последнего межсессионного периода. Он отметил успешное проведение информационных сессий, которые предшествовали ИНФКОМ-3 и которые дали возможность привлечь к работе Комиссии экспертов нового поколения. Он также подчеркнул важность потребностей пользователей, определенных Комиссией по обслуживанию, которые помогают Комиссии привлекать новые технологии и возможности. В заключение он выразил желание поблагодарить Секретариат, сотрудников по конференционному обслуживанию, а также письменных и устных переводчиков за их активную поддержку. Он высоко оценил дух сотрудничества, который Члены и технические эксперты приносят в сообщество.

23. В рамках [решения 34 \(ИНФКОМ-3\)](#) было установлено, что Комиссия в принципе проведет следующую(ие) очередную(ые) сессию(и) в 2026 году в штаб-квартире ВМО в Женеве, Швейцария.

24. Третья сессия Комиссии завершилась в 15:27 19 апреля 2024 года.

ПРИЛОЖЕНИЕ 1. ПОВЕСТКА ДНЯ

1. Повестка дня и организация сессии

- 1.1 Открытие сессии
- 1.2 Утверждение повестки дня
- 1.3 Рассмотрение доклада о полномочиях
- 1.4 Учреждение комитетов
- 1.5 Записи

2. Доклад президента Комиссии, в том числе доклады председателей вспомогательных органов

3. Проекты резолюций, решений и рекомендаций, подлежащие принятию консенсусом без обсуждения

4. Рассмотрение ранее вынесенных решений Конгресса, Исполнительного совета и Комиссии

- 4.1 Рассмотрение ранее принятых резолюций и рекомендаций Комиссии
- 4.2 Рассмотрение резолюций и решений Конгресса и Исполнительного совета, относящихся к Комиссии

5. Рассмотрение относящихся к Комиссии программ ВМО, включая стратегическое планирование

6. Программа работы и вспомогательные органы на следующий межсессионный период

- 6.1 Программа работы на следующий межсессионный период
- 6.2 Вспомогательные органы на следующий межсессионный период

7. Стратегические приоритеты

- 7.1 Приоритетные виды деятельности и план действий для инициативы «Заблаговременные предупреждения для всех»
- 7.2 План осуществления Глобальной службы наблюдения за парниковыми газами
- 7.3 Экологическая устойчивость

8. Технические решения

- 8.1 Сети Интегрированной глобальной системы наблюдений ВМО
- 8.2 Измерения в рамках Интегрированной глобальной системы наблюдений ВМО
- 8.3 Информационная система ВМО
- 8.4 Комплексная система обработки и прогнозирования ВМО

8.5 Кросс-системы

9. Координация и процедурные аспекты

9.1 Отношения с Организацией Объединенных Наций и другими организациями и программами

9.2 Координация с другими органами

10. Развитие потенциала

11. Гендерное равенство

12. Выборы должностных лиц

13. Сроки и место проведения следующих сессий

14. Закрытие сессии

ПРИЛОЖЕНИЕ 2. РЕЗОЛЮЦИИ, ПРИНЯТЫЕ СЕССИЕЙ

Резолюция 1 (ИНФКОМ-3)

Рассмотрение ранее принятых резолюций и рекомендаций Комиссии

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

рассмотрев ход выполнения предыдущих резолюций, решений и рекомендаций Комиссии, о котором сообщается в документе INFCOM-3/INF. 4.1,

принимая во внимание свод решений, которые были согласованы в ходе проведения настоящей сессии Комиссии,

постановляет:

1) оставить в силе следующие резолюции:

ИНФКОМ-1 (2020—2021 гг.):

- а) [резолюция 4 \(ИНФКОМ-1\)](#) «Будущее развитие Глобальной опорной сети наблюдений»;
- б) [резолюция 10 \(ИНФКОМ-1\)](#) «Круг ведения ведущих центров измерений»;
- в) [резолюция 11 \(ИНФКОМ-1\)](#) «Процесс назначения и мониторинга деятельности ведущих центров измерений»;
- г) [резолюция 12 \(ИНФКОМ-1\)](#) «Концепция центров Глобальной системы обработки данных и прогнозирования для гидрологического обслуживания»;

ИНФКОМ-2 (2022 г.):

- а) [резолюция 4 \(ИНФКОМ-2\)](#) «Устранение пробелов в интеграции криосферы в подход ВМО на основе системы Земля»;

2) не оставлять в силе другие резолюции, принятые до проведения настоящей сессии;

также постановляет:

1) сохранить в силе следующие решения:

ИНФКОМ-1 (2020—2021 гг.):

- а) [решение 5 \(ИНФКОМ-1\)](#) «Разработка плана осуществления Опорной сети приземных наблюдений Глобальной системы наблюдений за климатом»;
- б) [решение 11 \(ИНФКОМ-1\)](#) «Координация деятельности Комиссии по инфраструктуре с другими органами»;
- в) [решение 19 \(ИНФКОМ-1\)](#) «Назначение испытательного полигона ВМО для наземных комплексных метеорологических наблюдений, г. Чанша (Китай)»;

ИНФКОМ-2 (2022 г.):

- a) [решение 5 \(ИНФКОМ-2\)](#) «Стратегический подход ИНФКОМ»;
- b) [решение 7 \(ИНФКОМ-2\)](#) «Признание концепции многоуровневых сетей»;
- c) [решение 8 \(ИНФКОМ-2\)](#) «Руководящие указания по проведению верификации и калибровки приборов для измерения расхода и составлению соответствующих отчетов»;
- d) [решение 9 \(ИНФКОМ-2\)](#) «Назначение ведущего центра измерений ВМО по мониторингу снега — центр компетенции по мониторингу снега, Давос (Швейцария)»;
- e) [решение 10 \(ИНФКОМ-2\)](#) «Рекомендации Исследовательской группы по наблюдениям за океаном и инфраструктурным системам»;
- f) [решение 16 \(ИНФКОМ-2\)](#) «Процесс публикации серии технических документов»;
- g) [решение 17 \(ИНФКОМ-2\)](#) «На пути к совершенствованию оценок неопределенности и унификации терминологии по неопределенности в основных публикациях ВМО, связанных с ИНФКОМ»;

2) не оставлять в силе другие решения, принятые до проведения настоящей сессии;

далее постановляет не сохранять в силе ни одной рекомендации, принятой до настоящей сессии, отмечая, что эти рекомендации были приняты Девятнадцатым Всемирным метеорологическим конгрессом и Исполнительным советом, и их содержание было включено в публикации ВМО, такие как *Технический регламент (Сборник основных документов № 2* (ВМО-№ 49)), в соответствующих случаях.

Примечание: настоящая резолюция заменяет [резолюцию 5 \(ИНФКОМ-2\)](#), которая более не имеет силы.

Резолюция 2 (ИНФКОМ-3)

Программа работы на следующий межсессионный период

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 2 \(Кг-19\)](#) «Стратегический план ВМО на 2024-2027 годы», в которой поручено техническим комиссиям придерживаться перспективного видения и всеобъемлющих приоритетов, а также сосредоточить усилия и ресурсы на достижении долгосрочных целей и стратегических задач, изложенных в Плане,
- 2) [резолюцию 42 \(Кг-19\)](#) «Учреждение технических комиссий ВМО и дополнительных органов на девятнадцатый финансовый период», которая постановила продолжить действие в течение девятнадцатого финансового периода Комиссии по инфраструктуре с пересмотренным кругом ведения,

- 3) [резолюции 62 \(Кг-19\)](#) «Обзор ранее принятых резолюций Конгресса», в которой сохранена на девятнадцатый финансовый период программа Всемирной службы погоды (ВСП) и поручено Комиссии по инфраструктуре разработать расширенную программу, как результат эволюции программы ВСП,
- 4) [резолюцию 1 \(ИНФКОМ-2\)](#) «Программа работы Комиссии», в которой поручено Группе управления продолжить поддержание, обновление, а также обеспечить регулярное рассмотрение и пересмотр приоритетов перечня результатов работы и обязанностей и представить необходимые результаты Комиссии на ее следующей сессии,

рассмотрев:

- 1) ход осуществления программы работы на предыдущий межсессионный период 2022—2024 годов, представленный в докладе президента Комиссии, в том числе в докладах председателей вспомогательных органов (INFCOM-3/INF. 2),
- 2) ход осуществления соответствующих действий, связанных с ранее принятыми резолюциями, решениями и рекомендациями Комиссии по инфраструктуре, как указано в документе INFCOM-3/INF. 4.1,
- 3) действия, предпринятые в ответ на директивы, адресованные Конгрессом и Исполнительным советом Комиссии и президенту с момента проведения первой сессии, как указано в документе INFCOM-3/INF. 4.2,

приняв во внимание:

- 1) вспомогательные органы Комиссии на следующий межсессионный период, предложенные в [резолюции 3 \(ИНФКОМ-3\)](#),
- 2) необходимость наличия подхода для определения и обновления программы работы Комиссии, которая направлена на осуществление Стратегического плана и служит практическим инструментом планирования и мониторинга для содействия осуществлению научных и технических программ, относящихся к Комиссии, особенно расширенной программы ВСП,
- 3) описание проекта расширенной программы ВСП, как одной из основных программ ВМО, и связанной с ней Космической программы, представленное в [рекомендации 1 \(ИНФКОМ-3\)](#), в котором определены виды деятельности, осуществляемые Комиссией по инфраструктуре в каждой компонентной системе,

утверждает программу работы Комиссии на третий межсессионный период (2024—2026 гг.), представленную в дополнении к настоящей резолюции, с перечнем видов деятельности и результатов работы, касающихся компонентных систем и кросс-систем;

порукает Группе управления в консультации с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (Комиссия по обслуживанию), Советом по исследованиям, группами экспертов Исполнительного совета и региональными ассоциациями, а также при поддержке Секретариата:

- 1) продолжить поддержание, обновление, а также обеспечить регулярное рассмотрение и пересмотр приоритетов перечня видов деятельности и результатов работы, включая незначительные и умеренные изменения в осуществляемой под руководством ИНФКОМ деятельности, предусмотренной Планом действий ВМО в области гидрологии на 2023—2030 годы, а также обязанностей, содействуя обеспечению и оптимизации взаимосвязи между вспомогательными органами

Комиссии и с другими техническими органами и рабочими группами региональных ассоциаций, и представлять необходимые результаты на будущих сессиях;

- 2) рассмотреть вопрос об установлении улучшенного графика обновления нормативных материалов в рамках категории (1) рабочей программы для улучшения координации соответствующих обновлений между компонентными системами (Интегрированной глобальной системы наблюдений ВМО, Информационной системы ВМО и Комплексной системы обработки и прогнозирования ВМО), а также механизма мониторинга и оценки статуса внедрения изменений Членами, прежде чем переходить к следующему обновлению, чтобы включать извлеченные уроки;
- 3) рассмотреть подход для определения программы работы и предложить, при необходимости, усовершенствованный подход для определения и обновления программы работы, а также мониторинга и оценки ее осуществления, учитывая описание программы, которое будет принято, и пересмотр основанного на программах подхода ВМО и соответствующих процессов планирования, составления программ и бюджета, проведенный Исполнительным советом;

предлагает Членам и организациям-партнерам назначить экспертов в Сеть экспертов для поддержки осуществления программы работы.

Примечание: настоящая резолюция заменяет [резолюцию 1 \(ИНФКОМ-2\)](#), которая более не имеет силы.

Дополнение к резолюции 2 (ИНФКОМ-3)

Программа работы на следующий межсессионный период

Виды деятельности и соответствующие результаты работы перечислены в отношении кросс-систем — Интегрированной глобальной системы наблюдений ВМО (ИСГНВ), Информационной системы ВМО (ИСВ) и Комплексной системы обработки и прогнозирования ВМО (КСОПВ) - в трех категориях:

- 1) деятельность по разработке, техническому обслуживанию и мониторингу в 2024–2025 годах (например, обновление наставлений и руководств, мониторинг соответствия);
- 2) конкретные элементы/приоритетные направления Стратегического плана на 2024–2027 годы в рамках каждой соответствующей стратегической задачи (СЗ) в 2024–2025 годах;
- 3) изучить новые инициативы, которые будут продвигаться в следующий межсессионный период (2025–2026 гг.).

Дополнительная информация приведена в документе INFCOM-3/INF. 6.1 по пунктам, отмеченным символом (*).

Сети Интегрированной глобальной системы наблюдений ВМО (ИГСНВ)

Примечание: приведенные ниже виды деятельности, способствующие развитию и реализации аспекта, касающегося сетей ИГСНВ, осуществляются под руководством Постоянного комитета по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ), при содействии и участии соответствующей Консультативной группы в осуществлении деятельности, характерной для соответствующей области системы Земля, отражающей экспертный опыт и содействие привлечению партнеров, которые необходимы для успешного достижения результатов.

- 1) Деятельность по разработке, техническому обслуживанию и мониторингу в 2024–2025 годах (например, обновление наставлений и руководств, мониторинг соответствия):
 - Разработка поправок к *Наставлению по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1160).
 - Разработка обновленного содержания *Руководства по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1165).
 - Осуществление *Перспективного видения в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году* (ВМО-№ 1243), оценка потребностей в обновлении и разработка соответствующих обновлений.
 - Осуществление *High-Level Guidance (HLG) on the Evolution of Global Observing Systems during the period 2023–2027 in response to the Vision* (Руководящие указания высокого уровня (РУВУ) по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение) (WMO-№. 1334), оценка потребностей в обновлении и разработка соответствующих обновлений.
 - Осуществление Глобальной опорной сети наблюдений (ГОСН), Региональной опорной сети наблюдений (РОСН) и Опорной сети приземных наблюдений Глобальной системы наблюдений за климатом (ГСНК) во всех регионах.
 - Разработка дорожной карты расширения ГОСН.
 - Введение в эксплуатацию региональных центров ИГСНВ (РЦИ) и при необходимости расширение их сферы деятельности и функций.
 - Эволюция и совершенствование инструментов ИГСНВ, в частности, внесение вклада в новую версию Инструмента анализа и обзора возможностей систем наблюдений (ОСКАР)/Поверхность*, а также дополнительные модули и функции веб-инструмента Системы мониторинга качества данных ИГСНВ (СМКДИ).
 - Изучение последствий и сметных расходов, связанных с обновлением инструментов Информационного ресурса ИГСНВ и *Стандарта метаданных ИГСНВ* (ВМО-№ 1192), с учетом потребностей Членов.
 - Выполнение процесса регулярного обзора потребностей (РОП) ИГСНВ в целях завершения разработки заявлений о руководящих принципах по всем категориям применений системы Земля (КПСЗ).
 - Разработка дополнительных требований для ГОСН и РОСН к наблюдениям за океаном и улучшение представления информации о наблюдениях за океаном в ОСКАР/Поверхность и СМКДИ.
 - Укрепление процесса национального осуществления ИГСНВ посредством необходимого развития потенциала, заключения партнерских соглашений и формирования культуры соблюдения технических регламентов, связанных с ИГСНВ.
 - Разработка соответствующих планов осуществления и планов работы, а также нормативного материала по гидрологическим наблюдениям.

- Улучшение представления наблюдений за криосферой, в полярных и высокогорных регионах в ОСКАР/Поверхность и усвоения данных и разработка соответствующих требований к наблюдениям.
- Организация и проведение глобального показательного проекта по беспилотным авиационным системам (БАС).
- Обновление нормативного и руководящего материала, касающегося самолетных наблюдений и доступности данных, включая репозиторий Метаданных самолетных наблюдений (СН).
- Разработка предварительного документа с изложением позиции ВМО по повестке дня Всемирной конференции радиосвязи (ВКР-27) 2027 года и назначение национальных координаторов по вопросам радиочастот, оказание им поддержки в привлечении национальных регулирующих органов к решению важных вопросов ИГСНВ/ВМО.
- Разработка обновленного содержания Справочника Международного союза электросвязи (МСЭ)/ВМО *«Использование радиочастотного спектра в метеорологии: прогнозирование и мониторинг погоды, климата и качества воды»* (ВМО-№ 1197).
- Расширение доступа и возможностей Членов для использования данных и продукции космических систем.
- Реализация стратегии Виртуальной лаборатории ВМО-КГМС (Координационная группа по метеорологическим спутникам) по образованию и подготовке кадров в области спутниковой метеорологии на 2024–2027 годы ([резолюция 33 \(ИС-76\)](#)).
- Пересмотр *Руководства по сети прямого вещания для ретрансляции данных с низкоорбитальных спутников в режиме времени, близком к реальному* (ВМО-№ 1185).
- Содействие развитию потенциала и разработке удобных для пользователей информационно-разъяснительных материалов.
- Организация проведения 8-го практического семинара ВМО по влиянию различных систем наблюдений на численное прогнозирование погоды и прогнозирование состояния системы Земля.
- Решение проблем и улучшение согласованности и совместимости метаданных ИГСНВ и ИСВ в сотрудничестве с Постоянным комитетом по управлению информацией и информационным технологиям (ПК-УИИТ).

Результаты работы:

- Поправки к *Наставлению по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1160).
- Обновленное содержание *Руководства по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1165).
- Обновленное *Перспективное видение в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году* (ВМО-№ 1243).

- Обновленное содержание *High-Level Guidance (HLG) on the Evolution of Global Observing Systems during the period 2023–2027 in response to the Vision* (Руководящие указания высокого уровня (РУВУ) по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение) (WMO-No. 1334).
- Назначены дополнительные опорные станции ГОСН, РОСН и ГСНК в ОСКАР/Поверхность и улучшен международный обмен данными.
- Разработан документ с описанием дорожной карты расширения ГОСН.
- Во всех регионах созданы региональные центры ИГСНВ и все Члены охвачены функциями РЦИ, мониторинг ГОСН и РОСН работает в оперативном режиме, налажен процесс аудита.
- Инструменты ИГСНВ усовершенствованы и расширены за счет интеграции большего числа наблюдений за системой Земля (ОСКАР/Поверхность, СМКДИ, Система менеджмента инцидентов (СМИ)).
- Разработан отчет о последствиях и сметных расходах, связанных с обновлением инструментов Информационного ресурса ИГСНВ и *Стандарта метаданных ИГСНВ* (ВМО-№ 1192) для обеспечения согласованности с последними руководящими указаниями Организации Объединенных Наций по картам и инструментам картирования.
- Процесс РОП ИГСНВ полностью работает, разработаны ЗРП по всем КПСЗ.
- Требования к наблюдениям за океаном задокументированы в ОСКАР/Поверхность; дополнительные морские станции включены в ОСКАР/Поверхность.
- Больше Членов полностью внедрили ИГСНВ и улучшили соблюдение технических регламентов, связанных с ИГСНВ.
- Разработаны нормативные материалы, включая руководящие указания по проектированию сетей, и соответствующие планы, в частности, План осуществления Всемирной инициативы по данным о воде, проект плана работы для Глобальных центров гидрологических данных ВМО и Оперативный план ГидроХаб-ВСНГЦ (Всемирная система наблюдений за гидрологическим циклом).
- Увеличено число наблюдений за криосферой, в полярных и высокогорных районах, представленных в ОСКАР/Поверхность, улучшено усвоение данных, разработаны требования к наблюдениям.
- Завершен показательный проект по беспилотным летательным аппаратам (БПЛА); разработан отчет с рекомендациями.
- Обновлено нормативные и руководящие материалы по самолетным наблюдениям, запущен репозиторий Метаданных самолетных наблюдений (PM-SN), созданы Ведущий центр по СН и СМКДИ СН.
- Подготовлен предварительный документ с изложением позиции ВМО по повестке дня ВКР-27. Назначены национальные координаторы (НК) по вопросам радиочастот (РЧ), внедрена стратегия взаимодействия НК по вопросам РЧ, запланированная на 2024—2025 годы.

- Обновленный *Справочник МСЭ/ВМО «Использование радиочастотного спектра в метеорологии: прогнозирование и мониторинг погоды, климата и качества воды»* (ВМО-№ 1197).
 - Больше Членов имеют доступ к данным космических систем и возможность их использовать.
 - Внедрена Стратегия Виртуальной лаборатории ВМО-КГСМ для образования и подготовки кадров в области спутниковой метеорологии на 2024—2027 годы.
 - Обновленное *Руководство по сети прямого вещания для ретрансляции данных с низкоорбитальных спутников в режиме времени, близком к реальному* (ВМО-№ 1185).
 - Выявлены и задокументированы потребности в развитии потенциала, улучшен гендерный и региональный баланс в составе Постоянного комитета по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ), улучшена деятельность по привлечению молодых экспертов и планированию преемственности.
 - Организован 8-й семинар ВМО по влиянию различных систем наблюдений на численное прогнозирование погоды и прогнозирование состояния системы Земля, подведены итоги и разработаны рекомендации.
 - Улучшены согласованность и совместимость метаданных ИГСНВ и ИСВ.
- 2) Конкретные элементы/приоритетные направления Стратегического плана в рамках каждой соответствующей СЗ в 2024—2025 годах:
- Реагировать на потребности ЗПДВ в наблюдениях, в частности, за установленными приоритетными опасными явлениями; использовать РОП и РОСН.
 - Продолжать дальнейшую интеграцию областей в ИГСНВ, включая новые сети и подходы.
 - Дальнейшее развитие и осуществление программы аудита региональных центров ИГСНВ.
 - Содействовать обеспечению разработки программ наблюдений ВМО экологически устойчивым образом.
 - Проверка концепции многоуровневой сети в рамках экспериментальных проектов и ее дальнейшее развитие.
 - Вносить вклад в План осуществления Глобальной службы наблюдения за парниковыми газами (ПО-ГСНПГ) по мере необходимости.

Результаты работы:

- Выявлены пробелы в наблюдениях, а также пробелы и потребности в обучении по вопросам доступа к продукции/применениям систем наземного и космического базирования и их использования в ответ на инициативу «Заблаговременные предупреждения для всех» (ЗПДВ).
- Разработан и утвержден План осуществления Опорной сети приземных наблюдений ГСНК.

- Налажен процесс аудита региональных центров ИГСНВ (РЦИ).
- Разработаны соответствующие руководящие материалы.
- При необходимости внесен вклад в План осуществления ГСНПГ.
- Проведены экспериментальные проекты по многоуровневой сети, в соответствии с этим концепция получила дальнейшее развитие.

3) Изучить новые инициативы, которые будут продвигаться в следующий межсессионный период (2025—2026 гг.):

- Содействовать ВМО в установлении более тесных связей с международным спутниковым сообществом, начиная с криосферы и включая сообщества в других областях, в сотрудничестве с другими соответствующими группами.
- Сотрудничать с другими вспомогательными органами ИНФКОМ (например, ПК-МПСЗ) в отношении таких видов деятельности, как добровольные наблюдения и «краудсорсинг», интернет вещей, искусственный интеллект (ИИ) и экзафлопсные вычисления.

Результаты работы:

- Симпозиум по наблюдению за криосферой из космоса в сотрудничестве с операторами спутников и в координации с другими соответствующими мероприятиями.
- Выводы на основе полученных результатов, включая возможные предложения по экспериментальным проектам или интеграции этих источников в оперативную практику в зависимости от степени их зрелости.

Измерения в рамках ИГСНВ

Примечание: приведенные ниже виды деятельности, способствующие развитию и реализации аспекта, касающегося измерений в рамках ИГСНВ, осуществляются под руководством Постоянного комитета по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП), при содействии и участии соответствующей Консультативной группы в осуществлении деятельности, характерной для соответствующей области системы Земля, отражающей экспертный опыт и содействие привлечению партнеров, которые необходимы для успешного достижения результатов.

1) Деятельность по разработке, техническому обслуживанию и мониторингу в 2024–2025 годах (например, обновление наставлений и руководств, мониторинг соответствия):

- Разработать/обновить стандарты/передовую практику измерений и провести оценку/обеспечить согласованность между различными публикациями ВМО.
- Содействовать прослеживаемости измерений к признанным стандартам и обеспечить стабильность эталонов, установленных ВМО (Мировой радиационный эталон и Группа мировых ИК-эталонов).
- Отслеживать эффективность работы региональных центров, связанных с измерениями, включая рассмотрение вопроса об обновлении процесса оценки в соответствии с процессами, которые используются для других типов центров ИНФКОМ.

- Упорядочить концепцию региональных центров, связанных с измерениями.
- Укрепить сотрудничество с ведущими центрами измерений.
- Сотрудничать с другими международными организациями (например, Международное бюро мер и весов (МБМВ), Международная организация по стандартизации (ИСО), Ассоциация производителей гидрометеорологического оборудования (ПГМО), МОК (Межправительственная океанографическая комиссия)/ГСНО (Глобальная система наблюдений за океаном)) по вопросам разработки соответствующих стандартов/передовой практики.

Результаты работы:

- Новое издание *Руководства по приборам и методам наблюдений* (ВМО-№ 8)
 - Новое издание *Guide to Operational Weather Radar Best Practices* (Руководство по передовой практике использования оперативных метеорологических радиолокаторов) (WMO-No. 1257)
 - Обновление классификации выбора местоположения и таблицы неопределенностей приборов («Приложение 1А»)
 - Проведены 14-е Международное сравнение пигелиометров (МСП-XIV) и 4-е Международное сравнение пиргеометров (МСПг-IV) (подтверждена стабильность эталонов, оценены характеристики потенциальных новых эталонов)
 - Проведены межлабораторные сравнения и опубликован отчет
 - Опубликованы отчеты по приборам и методам наблюдений (ПМН) в отношении передовой практики измерений (например, межлабораторные сравнения).
 - Отчет(ы) о работе центров, связанных с измерениями
 - Ведущие центры измерений активно участвуют в деятельности Постоянного комитета по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП)
 - Разработаны стандарты, включая вклад ВМО
 - Вклад в подготовку обновленного и пересмотренного содержания Руководства по гидрологической практике, *Guidelines on the role, operation and management of National Hydrological Services* (Руководящие принципы, касающиеся роли, функционирования национальных гидрологических служб и управления ими) (WMO-No. 1003) и Международного гидрологического словаря (ВМО-№ 385) в сотрудничестве с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) и Организацией Объединенных Наций по вопросам образования, науки и культуры (ЮНЕСКО).
- 2) Конкретные элементы/приоритетные направления Стратегического плана в рамках каждой соответствующей СЗ в 2024—2025 годах:
- Выявить новые/появляющиеся технологии/методы измерений и разработать соответствующий руководящий материал.

- Пересмотреть, обновить и разработать классификации, включая сбор исследований, проведенных Членами.
- Разработать процедуры испытания автоматических метеорологических станций (АМС), в частности универсальных АМС и более экономичных АМС.
- Разработать руководящий материал по минимизации воздействия на окружающую среду систем наблюдений, связанных с работой станций.
- Разработать и провести программы и мероприятия по развитию потенциала, связанные с передовой практикой и технологиями измерений и соответствующей информационно-разъяснительной работой, включая практику калибровки/проверки в условиях эксплуатации/технического обслуживания.
- Вклад в оценку всемирной базы данных по экстремальным метеорологическим и климатическим явлениям и в механизм признания ВМО станций долгосрочных наблюдений.

Результаты работы:

- Опубликован руководящий материал по новым технологиям
- Разработаны процедуры испытания универсальных АМС
- Опубликована передовая практика, связанная с экологически устойчивой эксплуатацией станций, в ВМО-№ 8
- Организованы технические конференции (ТЕКО (Техническая конференция ВМО по приборам и методам наблюдений в области метеорологии и окружающей среды), Конференция по АМС) и практические семинары по экологической устойчивости
- Опубликован учебный материал по практике калибровки/проверки в условиях эксплуатации/технического обслуживания
- Обновлено системы компетенций
- Назначены станции долгосрочных наблюдений
- Передовая практика наблюдений за переменными состояниями морского льда в увязке с требованиями к наблюдениям (в виде главы 5, том II, ВМО-№ 8)
- Разработка нормативного и руководящего материала по гидрометрии на основе, в частности, Проекта по оценке эффективности работы приборов и методов измерения расхода воды (Проект X) и инновационного компонента ГидроХаб, связанного с приборами. (например, сеть гидрологических наблюдений, измерение отложений, безопасность на местах, качество воды)
- Разработать проекты новых изданий *Руководства по гидрологической практике, том I и том II* (ВМО-№ 168)*, *Guidelines on the role, operation and management of National Hydrological Services* (Руководящие принципы, касающиеся роли, функционирования национальных гидрологических служб и управления ими) (WMO-No. 1003) и *Международного гидрологического словаря* (ВМО-№ 385)* в координации с СЕРКОМ, Координационной группой экспертов по гидрологии (КГЭГ) и (только в отношении словаря) с ЮНЕСКО.

- 3) Изучить новые инициативы, которые будут продвигаться в следующий межсессионный период:
- Сотрудничать с потенциальными руководителями взаимосравнений при планировании проведения взаимосравнений приборов.
 - Взаимодействовать с Консультативной группой по Глобальной службе наблюдения за парниковыми газами (КГ-ГСНПГ) в изучении синергии, связанной с развертыванием станций наблюдений, центров калибровки и других аспектов, связанных с измерениями.

Результаты работы:

- Согласован план проведения взаимосравнений
- План взаимодействия с сообществом ГСНПГ по аспектам, связанным с измерениями

Информационная система ВМО (ИСВ)

Примечание: приведенные ниже виды деятельности, способствующие развитию и реализации ИСВ, осуществляются под руководством Постоянного комитета по управлению информацией и информационным технологиям (ПК-УИИТ), при содействии и участии соответствующей Консультативной группы в осуществлении деятельности, характерной для соответствующей области системы Земля, отражающей экспертный опыт и содействие привлечению партнеров, которые необходимы для успешного достижения результатов.

- 1) Деятельность по разработке, техническому обслуживанию и мониторингу в 2024–2025 годах (например, обновление наставлений и руководств, мониторинг соответствия):
- Обновить *Наставление по Информационной системе ВМО* (ВМО-№ 1060):
 - o Добавить Основной профиль метаданных ВМО 2.0.
 - o Добавить Иерархию тем ИСВ2.
 - o Добавить Уведомляющее сообщение ИСВ2.
 - o Обновить список центров ИСВ в томе II (ИСВ 2.0).
 - Обновить *Руководство по Информационной системе ВМО* (ВМО-№ 1061):
 - o Добавить новый том, посвященный руководящим указаниям, касающимся ИСВ 2.0.
 - o Предоставить руководящие указания по обеспечению ИТ-безопасности.
 - o Обновить компетенции в области ИСВ.
 - Обновить *Наставление по кодам, том I.2* (ВМО-№ 306):
 - o Обновить Представление метаданных ИГСНВ.
 - o Обновить стандарты и профили двоичной универсальной формы для представления метеорологических данных (BUFR), формата двоичных значений на сетке (GRIB) и общего сетевого формата данных (netCDF), которые требуются Членам.

- Внедрить мониторинг ИСВ 2.0 и осуществлять мониторинг перехода от ИСВ и Глобальной системы телесвязи (ГСТ) к ИСВ 2.0:
 - o Разработать и осуществлять мониторинг ключевых показателей эффективности (КПЭ) для перехода от ИСВ/ГСТ к ИСВ 2.0.
 - o Готовить периодические отчеты о ходе выполнения перехода от ИСВ/ГСТ к ИСВ 2.0.

Результаты работы:

- Опубликовано Наставление по ИСВ, том II, посвященный ИСВ 2.0
 - Опубликовано [Руководство по Информационной системе ВМО](#) (ВМО-№ 1061), том II, ИСВ 2.0
 - Опубликованы руководящие указания по обеспечению перехода от ИСВ/ГСТ к ИСВ 2.0.
- 2) Конкретные элементы/приоритетные направления Стратегического плана в рамках каждой соответствующей СЗ в 2024—2025 годах:
- Внедрить глобальную инфраструктуру ИСВ 2.0 и обеспечить ее функционирование:
 - o Внедрить глобальные брокеры, глобальные кэши, глобальные каталоги метаданных в области обнаружения, глобальный мониторинг.
 - o Провести нагрузочное испытание компонентов глобальной инфраструктуры ИСВ 2.0, чтобы убедиться, что они способны обеспечить необходимый для работы уровень обслуживания.
 - Переход Членов от ИСВ/ГСТ к ИСВ 2.0:
 - o Представить положения о переходе от ИСВ/ГСТ к ИСВ 2.0.
 - o Обучение Членов по вопросам внедрения узла ИСВ 2.0, а также доступа к данным из ИСВ 2.0 и их использования.
 - o Оказать поддержку дальнейшей разработке программного обеспечения «ИСВ2 в коробке» в качестве решения с открытым исходным кодом для использования Членами и частным сектором.
 - Интеграция всех дисциплин и областей ВМО в ИСВ 2.0:
 - o Обновить иерархию тем ИСВ 2.0 для конкретных областей.
 - Функциональная совместимость с системами совместного использования данных организаций-партнеров:
 - o Руководящие указания по функциональной совместимости между ИСВ 2.0 и Общесистемным управлением информацией (SWIM) Международной организации гражданской авиации (ИКАО)
 - o Руководящие указания по функциональной совместимости с Системой океанических данных и информации (СОДИ)

- Эволюция ИСВ 2.0:
 - Учреждение Исследовательской группы по будущей инфраструктуре данных (ИГ-БИД) для выявления потребностей в развитии ключевой инфраструктуры КСОПВ и ИСВ
 - Стандартизация сбора данных «первой мили» с платформ наблюдений
- Обеспечение согласованности Управления климатическими данными с ИСВ 2.0:
 - Модель климатических данных, которая будет использоваться для обмена данными, и системы управления климатическими данными.
 - Обзор технических регламентов, связанных с Управлением климатическими данными.
 - Объединить технические требования.
 - Обновить руководящие указания по управлению информацией в [Руководстве по Информационной системе ВМО](#) (ВМО-№ 1061).

Результаты работы:

- Рекомендации Исследовательской группы по будущей инфраструктуре данных (ИГ-БИД) в отношении последующих этапов КСОПВ и ИСВ, которые будут представлены ИНФКОМ на ее 4-й сессии
- Обзорная публикация по бизнес-моделям и концепциям для будущей инфраструктуры данных ИСВ
- Предложение по стандартизации сбора данных «первой мили», которое будет представлено ИНФКОМ на ее 4-й сессии и Исполнительному совету
- Отчет о ходе осуществления ИСВ 2.0 на экспериментальном этапе
- Руководящие указания по стандартам сбора данных «первой мили»
- Опубликованы положения о переходе от ИСВ/ГСТ к ИСВ 2.0
- Глобальная инфраструктура ИСВ 2.0 введена в эксплуатацию в 2025 году

Комплексная система обработки и прогнозирования ВМО (КСОПВ)

Примечание: приведенные ниже виды деятельности, способствующие развитию и реализации КСОПВ, осуществляются под руководством Постоянного комитета по Комплексной системе обработки и прогнозирования ВМО (ПК-КСОПВ), в сотрудничестве с СЕРКОМ и при содействии и участии соответствующей Консультативной группы в осуществлении деятельности, характерной для соответствующей области системы Земля, отражающей экспертный опыт и содействие привлечению партнеров, которые необходимы для успешного достижения результатов.

- 1) Деятельность по разработке, техническому обслуживанию и мониторингу в 2024–2025 годах (например, обновление наставлений и руководств, мониторинг соответствия):
 - Демонстрация и окончательная доработка процесса РОП КСОПВ

- Непрерывный обзор соответствия назначенных центров КСОПВ*
- Определение, разработка и демонстрация дополнительных видов обязательной и рекомендуемой продукции и обслуживания, таких как визуализация, для удовлетворения потребностей пользователей, особенно по линии инициативы «Заблаговременные предупреждения для всех» (ЗПДВ), и определение дополнительной продукции в качестве «основных данных» для реализации Единой политики ВМО в области данных
- Дальнейшее определение в качестве «основных данных» продукции назначенных центров КСОПВ в других областях системы Земля, помимо погоды и климата*
- Обзор и разработка обновленных процедур стандартизированной верификации глобального численного прогноза погоды (ЧПП)
- В сотрудничестве с региональными ассоциациями (РА) изучение и поддержка потенциальных Членов, которые могли бы разместить у себя центры КСОПВ, чтобы сделать необходимую продукцию более доступной*
- Пилотный проект по вкладу нетрадиционных источников в КСОПВ
- Уточнение оценочных показателей для сравнения данных климатического реанализа и выявление областей, требующих улучшения*
- Продвижение рекомендуемых действий в соответствии с дорожной картой интеграции криосферы в КСОПВ

Результаты работы:

- Поправки к *Техническому регламенту, том I* (ВМО-№ 49), *Наставлению по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485), и пересмотр *Руководства по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 305) по следующим пунктам:
 - Новые виды обязательной и рекомендуемой продукции, новые функции и, если необходимо, даже новые виды деятельности. Некоторые новые виды обязательной продукции будут рассматриваться в качестве «основных данных» в соответствии с Единой политикой ВМО в области данных
 - Отчет по результатам пилотного проекта по вкладу нетрадиционных источников в КСОПВ
 - Процесс РОП КСОПВ и заявления о руководящих принципах (снижение риска бедствий и климатическое обслуживание)
 - Обновленные процедуры стандартизированной верификации глобального детерминистского и ансамблевого ЧПП
- 2) Конкретные элементы/приоритетные направления Стратегического плана в рамках каждой соответствующей СЗ в 2024—2025 годах:
 - Обновление веб-портала КСОПВ для дальнейшего улучшения доступности и обнаруживаемости продукции КСОПВ*

- Активизация деятельности по развитию потенциала и информационно-просветительской деятельности с целью повышения потенциала Членов для использования продукции КСОПВ*.
- Инициирование экспериментального проекта для определения потребностей и возможности предоставления доступа к данным ЧПП высокого разрешения для прогона моделей по ограниченному району*

Результаты работы:

- Обновленная версия веб-портала КСОПВ
 - Материалы для обучения и информационно-просветительской деятельности по продукции КСОПВ
 - Материал, содержащий описание потребностей и возможности обеспечения доступа к данным ЧПП высокого разрешения
- 3) Изучить новые инициативы, которые будут продвигаться в следующий межсессионный период:
- В сотрудничестве с Советом по исследованиям (СИ) разработка и поддержка экспериментальных проектов КСОПВ для содействия внедрению новых технологий, особенно ИИ*

Результаты работы:

- Повышение качества продукции и обслуживания, предоставляемых назначенными центрами КСОПВ

Кросс-системы

- 1) Деятельность по развитию в 2024—2025 годах и ее вклад в реализацию стратегических задач в 2024—2025 годах:
- Разработать структурированный подход для обеспечения поддержки инфраструктурных компонентов Глобальной системы для оценки текущей гидрологической ситуации и ее ориентировочного прогнозирования (ГидроСОП)*, включая РОП и проектирование сети, управление данными и их совместное использование, а также моделирование и прогнозирование.
 - Поддержка инфраструктурных компонентов ежегодного доклада ВМО о состоянии глобальных водных ресурсов.
 - Разработать План осуществления Глобальной службы криосферы и отразить интеграцию деятельности в области криосферы в рамках ИГСНВ, ИСВ, КСОПВ, обеспечить скоординированное осуществление и взаимосвязь с деятельностью ИНФКОМ, программами и деятельностью ВМО (например, планы работы СЕРКОМ, СИ), а также соответствующими партнерами и международными программами, уделяя повышенное внимание региональным приоритетным потребностям.
 - Оказать поддержку внесению вклада в раздел о криосфере ежегодного доклада ВМО о состоянии климата.

- Организовать региональные практические семинары (региональные ассоциации (РА) II и III) по криосфере с участием соответствующих структур ИНФКОМ, СЕРКОМ и региональных ассоциаций, а также партнеров по исследованиям, способствующие активизации передачи знаний о передовой практике в области систем наблюдений за криосферой, получения спутниковых данных, обмена данными и доступа к ним, в поддержку реализации согласованных инициатив, например, осуществления сети региональных климатических центров третьего полюса (сеть РКЦТП).
- Укреплять и поддерживать необходимое взаимодействие и предпринять действия, предусмотренные дорожной картой интеграции криосферы в КСОПВ, утвержденной ИНФКОМ-3.

Результаты работы:

- Разработан структурированный подход для поддержки инфраструктурных компонентов ГидроСОП
 - Расширены наборы данных для ежегодного доклада ВМО о состоянии глобальных водных ресурсов
 - План осуществления Глобальной службы криосферы
 - Опубликован ежегодный доклад ВМО о состоянии климата с разделом о криосфере
 - Организованы региональные практические семинары (РА II, РА III) по криосфере
 - Дорожная карта интеграции криосферы в КСОПВ реализуется в соответствии с решением ИНФКОМ-3
- 2) Изучить новые инициативы, которые будут продвигаться в следующий межсессионный период:
- Разработать концепцию глобальных центров прогнозирования в высокогорных районах и изучить способы обеспечения потребности в репрезентативной продукции, касающейся горных районов, в различных масштабах в областях погоды, климата и гидрологии на основе опыта и взаимодействия по линии сети РКЦТП.
 - Антарктика и Южный океан (южнее 60° ю.ш.): повысить доступность критически важных наблюдений в Антарктике и расширить связи с научными исследованиями в поддержку улучшения оценок таяния Антарктического ледяного щита и его глобального воздействия, а также изучить возможности развития структур в рамках КСОПВ и ИГСНВ для удовлетворения потребностей в информации, например, РЦИ, региональных специализированных метеорологических центров, и оказания поддержки созданию сети антарктических региональных климатических центров (сеть АнТРКЦ).

Результаты работы:

- Разработана концепция глобальных центров прогнозирования в высокогорных районах

- Антарктика и Южный океан (южнее 60° ю. ш.) Инфраструктурный подход, согласующийся с координационным механизмом ВМО, который разработан Группой экспертов Исполнительного совета по полярным и высокогорным наблюдениям, исследовательской деятельности и обслуживанию (ПВНИДО)

Экологическая устойчивость (вклад в С35.4)

[Виды деятельности и результаты работы, предложенные в [решении 7 \(ИНФОМ-3\)](#).

Осуществление Единой политики в области данных

- 1) Деятельность по развитию в 2024—2025 годах и ее вклад в реализацию стратегических задач в 2024—2025 годах:
 - Определение основных и рекомендуемых данных наблюдений в областях системы Земля, как часть компонента сети ИГСНВ, который руководствуется потребностями областей применения и их сообществ пользователей (вклад в С32.1).
 - Определение видов обязательной и рекомендуемой продукции численного прогноза погоды и основных данных (как часть компонента КСОПВ, который руководствуется потребностями областей применения и обслуживания и их сообществ пользователей) (вклад в С32.3)
 - Оказать поддержку осуществлению ИСВ2.0 для всех центров ИСВ, в том числе в организациях, не относящихся к НМГС (национальные метеорологические и гидрологические службы) (вклад в С32.2)
 - Сбор и публикация руководящих материалов, включая тематические исследования и примеры, по различным аспектам (вклад в С32.1, 2.2 и 2.3)
 - Использовать возможности Фонда финансирования систематических наблюдений (ФФСН) и мероприятий по мобилизации ресурсов для ГСНПГ, гидрологии и криосферы для ускорения реализации политики в области данных (вклад в С32.1, 2.2 и 2.3)

Результаты работы:

- Определены основные и рекомендуемые данные наблюдений в областях системы Земля в Наставлении по Интегрированной глобальной системе наблюдений ВМО
- Определены виды обязательной и рекомендуемой продукции с указанием основных данных в [Наставлении по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 485)
- Больше данных подлежат обмену через ИСВ 2.0, и обеспечиваются механизмы мониторинга соответствия
- Руководящие материалы, включая тематические исследования и примеры, по различным аспектам, особенно по определению источников данных и партнерству с организациями, не относящимися к НМГС, включая научно-исследовательское сообщество.

Глобальная служба наблюдения за парниковыми газами (ГСНПГ)

- 1) Деятельность по развитию в 2024—2025 годах и ее вклад в реализацию стратегических задач в 2024—2025 годах:

- Разработка проекта сети наблюдений за парниковыми газами в поддержку осуществления ГСНПГ и установление требований к наблюдениям за парниковыми газами в различных областях (данный вид деятельности вносит вклад в С32.1)
- Создать исчерпывающий перечень существующих наблюдений за парниковыми газами для увеличения объема информации, доступной для моделирования (связано с С32.1 и 2.2)
- Создание системы управления данными для ГСНПГ, включая требования и исполнительные органы, с учетом потребностей в реализации Единой политики в области данных, и оценка применимости ИСВ для такой системы (связано с С32.2)
- Создание нормативной базы для оперативных центров ГСНПГ, включая определение требований к продукции моделирования (связано с С32.3)
- Создание первоначальных протоколов оценки области моделирования потоков парниковых газов (ПГ) (связано с С32.3)
- Создание механизма сотрудничества с СЕРКОМ и СИ для формирования цепочки создания стоимости и сбора потребностей пользователей (связь с С31.2 и С33.2)

Результаты работы:

- Требования к наблюдениям в поддержку ГСНПГ включены в ОСКАР/Потребности
- Расширение доступности данных наблюдений за ПГ
- Проект системы управления данными ГСНПГ
- Принятые протоколы ИСВ и разработанные стандарты метаданных для обмена данными по ПГ
- Наставление по КСОПВ обновлено и включает информацию по оперативным центрам ГСНПГ
- Разработаны методы и протоколы контроля качества и верификации результатов инфраструктуры
- Рекомендации по методологиям последующей обработки и привлечению пользователей к сотрудничеству с СИ и СЕРКОМ

Оценка, назначение и обзор соответствия центров (вклад в С32.1, С32.2, С32.3)

[Виды деятельности и результаты работы, предложенные в [решении 23 \(ИНФОМ-3\)](#)]

Резолюция 3 (ИНФОМ-3)

Учреждение постоянных комитетов, исследовательских групп и консультативных групп Комиссии по наблюдениям, инфраструктуре и информационным системам (Комиссии по инфраструктуре)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 2 \(Кг-19\)](#) «Стратегический план ВМО на 2024—2027 гг.», который определяет долгосрочные цели, стратегические задачи и приоритетные направления деятельности на 2024—2027 годы, в частности в области наблюдений и прогнозирования системы Земля в качестве Долгосрочной цели 2 с новыми стратегическими задачами:
 - а) 1.5. Ускорить разработку комплексных систем и обслуживания для устранения глобальных рисков, связанных с необратимыми изменениями в криосфере и последующими воздействиями на водные ресурсы и повышение уровня моря,
 - б) 5.4. Экологическая устойчивость,
- 2) [резолюцию 42 \(Кг-19\)](#) «Учреждение технических комиссий ВМО и дополнительных органов на девятнадцатый финансовый период», которая постановила продолжить работу Комиссии по инфраструктуре в течение девятнадцатого финансового периода с пересмотренным кругом ведения (КВ),
- 3) [резолюцию 62 \(Кг-19\)](#) «Обзор ранее принятых резолюций Конгресса», которая продолжила проведение Программы Всемирной службы погоды (ВСП) в девятнадцатом финансовом периоде и поручила Комиссии по инфраструктуре разработать расширенную программу в качестве развития Программы ВСП,
- 3) [резолюцию 5 \(Кг-19\)](#) «Глобальная служба наблюдения за парниковыми газами»,
- 4) [резолюцию 6 \(Кг-19\)](#) «Приоритетные задачи в свете глобального и регионального воздействия изменений в криосфере»,
- 5) [резолюцию 21 \(Кг-19\)](#) «Осуществление ГОСН»,
- 6) [резолюцию 22 \(Кг-19\)](#) «Стандартный словарь ВМО»,
- 7) [резолюцию 25 \(Кг-19\)](#) «Технический регламент Информационной системы ВМО 2.0»,
- 8) [резолюцию 26 \(Кг-19\)](#) «Комплексная система обработки данных и прогнозирования ВМО (КСОПВ)»,
- 9) [резолюцию 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля»,
- 10) [резолюцию 2 \(Кг-Внеоч.\(2021\)\)](#) «Поправки к Техническому регламенту, касающиеся создания Глобальной опорной сети наблюдений (ГОСН)»,
- 11) [резолюцию 4 \(Кг-Внеоч.\(2021\)\)](#) «Перспективное видение и Стратегия ВМО в области гидрологии и соответствующий План действий»,
- 12) [резолюцию 12 \(ИС-73\)](#) «Процесс аудита региональных центров ИГСНВ»,

13) [Правила процедуры для технических комиссий](#) (ВМО-№ 1240, издание 2023 г.),

ссылаясь далее на:

- 1) [резолюцию 1 \(ИНФКОМ-1\)](#) «Учреждение постоянных комитетов и исследовательских групп Комиссии по наблюдениям, инфраструктуре и информационным системам (Комиссии по инфраструктуре)»,
- 2) [резолюцию 2 \(ИНФКОМ-2\)](#) «Учреждение постоянных комитетов и исследовательских групп Комиссии по наблюдениям, инфраструктуре и информационным системам (Комиссии по инфраструктуре)»,

отмечая, что председатель/заместитель председателя постоянных комитетов по управлению информацией и информационным технологиям (ПК-УИИТ), по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля (ПК-МПСЗ) и по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ) являются назначенными членами Совместного совета по сотрудничеству между ВМО и МОК (ССС) и что в силу своих функций они будут обеспечивать взаимодействие между ИНФКОМ и СССР в целях укрепления сотрудничества в области морской инфраструктуры,

отмечая далее, что президент Комиссии представляет Комиссию в Совете по исследованиям (СИ) для обеспечения цикла создания ценности «исследования – эксплуатация»,

рассмотрев:

- 1) конкретный круг ведения Комиссии по наблюдениям, инфраструктуре и информационным системам (Комиссии по инфраструктуре) ([дополнение 1 к резолюции 42 \(Кг-19\)](#));
- 2) проект описания расширенной Программы ВСП как одной из основных программ ВМО и связанной с ней Космической программы, предложенный в [рекомендации 1 \(ИНФКОМ-3\)](#);
- 3) проект программы работы Комиссии на следующий межсессионный период, предложенный в [резолюции 2 \(ИНФКОМ-3\)](#);
- 4) необходимость обеспечения надлежащей координации постоянных комитетов, исследовательских групп и консультативных групп Комиссии с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (Комиссией по обслуживанию), СИ, региональными ассоциациями и другими органами и партнерскими организациями по вопросам Единой политики в области данных;
- 5) необходимость создания механизма координации и обмена знаниями на уровне Комиссии в целях деятельности по развитию потенциала,

постановляет учредить следующие постоянные комитеты на время третьего межсессионного периода с кругом ведения, определенным в дополнении к настоящей резолюции:

- a) Постоянный комитет по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ);
- b) Постоянный комитет по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП);

- с) Постоянный комитет по управлению информацией и информационным технологиям (ПК-УИИТ);
- д) Постоянный комитет по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля (ПК-МПСЗ) с новым названием Постоянный комитет по Комплексной системе обработки и прогнозирования ВМО (ПК-КСОПВ);

постановляет далее учредить следующие исследовательские группы, консультативные группы и должности координаторов на время третьего межсессионного периода с кругом ведения, определенным в дополнении к настоящей резолюции:

- е) Исследовательская группа по вопросам экологической устойчивости (ИГ-ЭКОУ) как согласовано в рамках [решения 7 \(ИНФКОМ-3\)](#);
- ф) Исследовательская группа по будущей инфраструктуре данных (ИГ-БИД) как согласовано в рамках [решения 17 \(ИНФКОМ-3\)](#);
- г) Исследовательская группа по оценке, назначению и обзору соответствия центров (ИГ-ОНОС) как согласовано в рамках [решения 23 \(ИНФКОМ-3\)](#);
- h) Консультативная группа по Глобальной службе криосферы (КГ-ГСК);
- i) Консультативная группа по океанам (КГ-Океан);
- j) Консультативная группа по гидрологии (КГ-Гидро) как согласовано в рамках [решения 22 \(ИНФКОМ-3\)](#);
- к) координатор по осуществлению Единой политики ВМО в области данных (К-ДАТА);
- l) координатор по развитию потенциала (К-РП);

порукает президенту при содействии Группы управления и поддержке Секретариата:

- 1) обеспечить отбор технических экспертов из сети экспертов для работы в вышеуказанных постоянных комитетах, исследовательских и консультативных группах, а также учредить группы экспертов и целевые группы, включая межкомиссионные механизмы, необходимые для завершения работы этих органов, принимая во внимание [Правила процедуры для технических комиссий](#) (ВМО-№ 1240, издание 2023 г.) и общие принципы отбора экспертов, обслуживающих вспомогательные органы, представленные в документе INF.COM-3/INF. 6.2;
- 2) обеспечить необходимое представительство в Комиссии по обслуживанию, СИ, ССС и вспомогательных органах Исполнительного совета, а также координацию с ними путем назначения представителей Комиссии и необходимых координаторов и регулярно информировать Членов о назначениях и состоянии представительства Комиссии и координации с другими органами;
- 3) рассмотреть и создать оптимальную рабочую структуру/механизм для:
 - а) деятельности в области космической погоды в соответствии с четырехлетним планом деятельности ВМО, связанной с космической погодой, на 2024–2027 годы, если он будет принят Исполнительным советом (см. [рекомендацию 13 \(ИНФКОМ-3\)](#));
 - б) координации деятельности, связанной со спутниками, для всех областей применения и во всех областях системы Земля и для взаимодействия с космическими агентствами-партнерами через Координационную группу по

метеорологическим спутникам (КГМС) и Комитет по спутниковым наблюдениям за Землей (КЕОС) (см. [решение 26 \(ИНФКОМ-3\)](#));

- с) координации, необходимой для разработки стандартного словаря ВМО в соответствии с [резолюцией 22 \(Кг-19\)](#) «Стандартный словарь ВМО»;
- 4) в консультации с Группой управления Комиссии по обслуживанию (см. решение 7 (СЕРКОМ-3)) и Координационной группой экспертов по гидрологии определить и создать соответствующий механизм для сотрудничества двух технических комиссий в проведении обзора и обновлении [Руководства по гидрологической практике](#) (ВМО-№ 168), том I, [Руководства по гидрологической практике](#) (ВМО-№ 168), том II, [Guidelines on the role, operation and management of National Hydrological Services](#) (Руководящих принципов, касающихся роли и функционирования национальных гидрологических служб и управления ими) (WMO-No. 1003) и, в сотрудничестве с ЮНЕСКО, [International Glossary for Hydrology](#) (Международного глоссария по гидрологии) (WMO-No. 385), как было предложено на шестом совещании Координационной группы экспертов по гидрологии;

уполномочивает президента скорректировать управление КГ-Океан в консультации с СЕРКОМ, СИ, ССС и другими соответствующими органами, по мере необходимости;

предлагает Членам назначать экспертов в сеть экспертов для поддержки работы вспомогательных органов Комиссии.

Примечание: настоящая резолюция заменяет [резолюцию 2 \(ИНФКОМ-2\)](#), которая более не имеет силы.

Дополнение к резолюции 3 (ИНФКОМ-3)

Круг ведения (КВ) постоянных комитетов, исследовательских групп, консультативных групп и координаторов

А. Постоянный комитет по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ)

[Цель, необходимые экспертные знания, членский состав и срок действия такие же, как в [дополнении к резолюции 2 \(ИНФКОМ-2\)](#)].

Порядок работы

Одно очное совещание в межсессионный период (что соответствует 2-летнему циклу). В ином случае — посредством электронной переписки и проведения теле/видеоконференции.

Регламентные и руководящие материалы, относящиеся к сфере компетенции Постоянного комитета:

- соответствующие части Технического регламента, [том I](#), [том II](#) и [том III](#) (ВМО-№ 49);
- [Наставление по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160);
- [Наставление по Глобальной структуре управления данными высокого качества по климату](#) (ВМО-№ 1238);

- Manual on Stream Gauging (Наставление по измерению расхода воды), [том I](#) и [том II](#) (WMO-No. 1044);
- [Руководство по климатологической практике](#) (ВМО-№ 100) (часть, имеющая отношение к климатическим наблюдениям, станциям и сетям, поддерживающая Постоянный комитет по климатическому обслуживанию);
- [Руководство по гидрологической практике](#) (ВМО-№ 168), том I;
- [International Glossary of Hydrology](#) (Международный глоссарий по гидрологии) (WMO-No. 385);
- [Руководство по Глобальной системе наблюдений](#) (ВМО-№ 488);
- [Руководство по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1165);
- [Guide to Aircraft-based Observations](#) (Руководство по самолетным наблюдениям) (WMO-No. 1200);
- [Руководство по участию в координации радиочастот](#) (ВМО-№ 1159);
- [Руководство по сети прямого вещания для ретрансляции данных с низкоорбитальных спутников в режиме времени, близком к реальному](#) (ВМО-№ 1185);
- [Технические руководящие принципы для региональных центров ИГСНВ по системе мониторинга качества данных ИГСНВ](#) (ВМО-№ 1224);
- [Перспективное видение в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году](#) (ВМО-№ 1243);
- Руководящие указания высокого уровня по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение (ВМО-№ 1334);
- [Справочник «Использование радиочастотного спектра в метеорологии: мониторинг и прогнозирование погоды, климата и качества воды»](#) (ВМО-№ 1197);
- [Satellite Data Telecommunication Handbook](#) (Справочник по спутниковой телесвязи для передачи данных) (WMO-No. 1223);
- [Руководящие принципы по наилучшим практикам обеспечения готовности пользователей к использованию новых спутниковых систем](#) (ВМО-№ 1187), название обновлено в рамках [резолюции 6 \(ИНФКОМ-3\)](#);
- [Climate Data Management System Specifications](#) (Спецификации Системы управления климатическими данными) (WMO-No. 1131);
- [Compendium of WMO Competency Frameworks](#) (Сборник систем компетенций ВМО) (WMO-No. 1209), включая [Руководящие принципы по навыкам и знаниям в области использования спутниковых данных для оперативных метеорологов](#) (Космическая программа ВМО (КП) № 12);
- готовящиеся к публикации руководящие документы:
 - Руководящие принципы по осуществлению региональных и национальных программ передачи метеорологических данных с самолета (АМДАР);

- Руководящие указания по региональной координации и осуществлению ИГСНВ и распределению ролей среди узловых региональных центров ИГСНВ (РЦИ);
- Руководящие принципы по проектированию сети гидрологических наблюдений.

Ожидаемые результаты

Планируемые результаты приведены в соответствии с программой работы Комиссии.

В. Постоянный комитет по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП)

[Цель, необходимые экспертные знания, членский состав и срок действия такие же, как в дополнении к резолюции 1 (ИНФКОМ-1)].

Порядок работы

Одно очное совещание в межсессионный период (что соответствует 2-летнему циклу). В ином случае — посредством электронной переписки и проведения теле/видеоконференции.

Регламентные и руководящие материалы, относящиеся к сфере компетенции Постоянного комитета

- Руководство по приборам и методам наблюдений (ВМО-№ 8), [том I](#), [том II](#), [том III](#), [том IV](#) и [том V](#);
- соответствующие части Технического регламента, [том I](#), [том II](#) и [том III](#) (ВМО-№ 49);
- [Международный атлас облаков — Наставление по наблюдению облаков и других метеоров](#) (ВМО-№ 407);
- [Наставление по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160);
- [Руководство по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1165);
- [Стандарт метаданных ИГСНВ](#) (ВМО-№ 1192);
- вклады в [WMO/GAW Aerosol Measurement Procedures, Guidelines and Recommendations](#) (Руководящие положения и рекомендации ВМО/ГСА по процедурам измерения аэрозолей) (WMO-No. 1177);
- [Руководство по гидрологической практике](#) (ВМО-№ 168), том I;
- [International Glossary of Hydrology](#) (Международный глоссарий по гидрологии) (WMO-No. 385);
- [Manual on Stream Gauging](#) (Наставление по измерению расхода воды), [том I](#) и [том II](#) (WMO-No. 1044);
- [Compendium of WMO Competency Frameworks](#) (Сборник систем компетенций ВМО) (WMO-No. 1209);

- общие стандарты ВМО-ИСО, которые включают, среди прочего, в соответствующих случаях, профилометры ветра, лидар обратного рассеяния частиц, доплеровский лидар, наземные метеорологические радары, эталонный дождемерный колодец, датчики глубины снежного покрова;
- отчеты по приборам и методам наблюдений;
- Руководящие положения по измерению наносов, безопасности в полевых условиях, качеству воды.

Ожидаемые результаты

Планируемые результаты приведены в соответствии с программой работы Комиссии.

С. Постоянный комитет по управлению информацией и информационным технологиям (ПК-УИИТ)

[Цель, необходимые экспертные знания, членский состав и срок действия такие же, как в [дополнении к резолюции 1 \(ИНФКОМ-1\)](#)].

Порядок работы

Одно очное совещание в межсессионный период (что соответствует 2-летнему циклу). В ином случае — посредством электронной переписки и проведения теле/видеоконференции.

Регламентные и руководящие материалы, относящиеся к сфере компетенции Постоянного комитета

- соответствующие части Технического регламента, [том I](#), [том II](#) и [том III](#) (ВМО-№ 49);
- [Наставление по Информационной системе ВМО](#) (ВМО-№ 1060), том I;
- [Наставление по кодам](#) (ВМО-№ 306), [том I.2](#) и [том I.3](#);
- [Наставление по Глобальной системе телесвязи](#) (ВМО-№ 386);
- [Наставление по Глобальной структуре управления данными высокого качества по климату](#) (ВМО-№ 1238);
- [Руководство по Информационной системе ВМО](#) (ВМО-№ 1061);
- [Руководство по управлению данными Всемирной службы погоды](#) (ВМО-№ 788);
- [Guide to Information Technology Security](#) (Руководство по безопасности информационных технологий) (WMO-No. 1115);
- [Guide to Virtual Private Networks](#) (Руководство по виртуальным частным сетям) (WMO-No. 1116);
- [Satellite Data Telecommunication Handbook](#) (Справочник по спутниковой телесвязи для передачи данных) (WMO-No. 1223);
- [Руководство по климатологической практике](#) (ВМО-№ 100), поддерживающее Постоянный комитет по климатическому обслуживанию;

- [Climate Data Management System Specifications](#) (Спецификации Системы управления климатическими данными) (WMO-No. 1131);
- [Compendium of WMO Competency Frameworks](#) (Сборник систем компетенций ВМО) (WMO-No. 1209);
- отчет о текущей деятельности глобальных центров данных наблюдений за различными компонентами системы Земля под эгидой ВМО и предложения по улучшению обслуживания потребителей информации.

Ожидаемые результаты

Планируемые результаты приведены в соответствии с программой работы Комиссии.

D. Постоянный комитет по Комплексной системе обработки и прогнозирования ВМО (ПК-КСОПВ)

[Цель, необходимые экспертные знания, членский состав и срок действия такие же, как в [дополнении к резолюции 2 \(ИНФКОМ-2\)](#), с заменой ГСОДП на Комплексную систему обработки данных и прогнозирования ВМО (КСОПВ) (в соответствии с [резолюцией 26 \(КГ-19\)](#))].

Порядок работы

Одно очное совещание в межсессионный период (что соответствует 2-летнему циклу). В ином случае — посредством электронной переписки и проведения теле/видеоконференции.

Регламентные и руководящие материалы, относящиеся к сфере компетенции Постоянного комитета

- соответствующие части Технического регламента, [том I](#), [том II](#) и [том III](#) (ВМО-№ 49);
- [Наставление по Комплексной системе обработки данных и прогнозирования ВМО](#) (ВМО-№ 485);
- [Руководство по Глобальной системе обработки данных и прогнозирования](#) (ВМО-№ 305);
- [Guidelines on High-resolution Numerical Weather Prediction](#) (Руководящие принципы по численному прогнозированию погоды с высоким разрешением) (WMO-No. 1311);
- [Guidelines on Ensemble Prediction System Postprocessing](#) (Руководящие принципы по системам ансамблевого прогнозирования и постпроцессингу) (WMO-No. 1254);
- [Руководящие принципы ВМО по созданию определенного набора национальной продукции климатического мониторинга](#) (ВМО-№ 1204);
- [Guidance on Verification of Operational Seasonal Climate Forecasts](#) (Руководство по верификации оперативных сезонных прогнозов климата) (WMO-No. 1220);
- [Compendium of WMO Competency Frameworks](#) (Сборник систем компетенций ВМО) (WMO-No. 1209);

- Руководство по оперативной практике объективного сезонного прогнозирования;
- Руководство по региональным проекциям изменения климата;
- Каталог ВМО по данным о системе Земля;
- [Guidelines for Nowcasting Techniques](#) (Руководящие указания по методам наукастинга) (WMO-No. 1198);
- План осуществления будущей бесшовной ГСОДП.

Ожидаемые результаты

Планируемые результаты приведены в соответствии с программой работы Комиссии.

Е. Исследовательская группа по вопросам экологической устойчивости (ИГ-ЭКОУ)

Цель

Под экологической устойчивостью понимается одна из стратегических задач в рамках Долгосрочной цели 5 [Стратегического плана ВМО \(2024–2027 гг.\)](#) (ВМО-№ 1336), принятой в [резолюции 2 \(Кг-19\)](#) «Стратегический план ВМО на 2024–2027 гг.». Кроме того, одно из приоритетных направлений задачи 2.1 Долгосрочной цели 2 обозначено как «обеспечение разработки программ наблюдений ВМО экологически устойчивым образом».

Исследовательская группа по вопросам экологической устойчивости (ИГ-ЭКОУ) создана для изучения воздействия на окружающую среду Интегрированной глобальной системы наблюдений ВМО (ИГСНВ), Информационной системы ВМО (ИСВ) и Комплексной системы обработки и прогнозирования ВМО (КСОПВ), а также для разработки осуществимых предложений и рекомендаций по минимизации этого воздействия без ущерба для преимуществ, обеспечиваемых этими системами. ИГ-ЭКОУ будет отчитываться перед Группой управления ИНФКОМ.

ИГ-ЭКОУ обеспечит выработку скоординированного подхода в рамках всей Комиссии и будет содействовать обмену опытом в этой новой области работы, актуальной для всех групп ИНФКОМ.

Состав

ИГ-ЭКОУ будет состоять из председателя или сопредседателей, обладающих опытом в области экологической устойчивости, связанной с ИГСНВ, ИСВ и/или КСОПВ, и экспертов, представляющих вспомогательные органы ИНФКОМ (назначаются соответствующим вспомогательным органом), с учетом гендерного и регионального баланса:

- по одному представителю от каждого постоянного комитета;
- по одному представителю от каждой консультативной группы;
- один представитель от ПГМО;
- при необходимости представитель других исследовательских/консультативных групп в зависимости от групп, принимаемых ИНФКОМ-З, с тем чтобы обеспечить представленность всех областей и сфер деятельности.

Порядок работы

Работа будет осуществляться по переписке по электронной почте и посредством проведения телеконференций с возможностью проведения совещаний в очной форме, если президент сочтет это целесообразным и при условии наличия ресурсов. Очные совещания будут приурочены к другим соответствующим событиям и мероприятиям (например, Всемирной выставке метеорологических технологий).

Планируемые результаты

ИГ-ЭКОУ выполнит следующие задачи и представит ИНФКОМ соответствующие результаты не позднее чем на ее четвертой сессии:

- разработает дорожную карту по достижению целей экологической устойчивости, указанных в Стратегическом плане ВМО, в отношении деятельности ИНФКОМ, включая:
 - рекомендации по минимизации воздействия систем ИГСНВ, ИСВ и КСОПВ на окружающую среду;
 - список мероприятий, связанных с экологической устойчивостью и подлежащих проведению ИНФКОМ в течение следующего межсессионного периода (2026—2027 гг.);
- проведет практические семинары по обмену передовым опытом в области экологической устойчивости с целью создания платформы для обмена идеями, наилучшими практиками и разработки совместных стратегий;
- проведет сбор информации о наилучших практиках, связанных с уменьшением воздействия ИГСНВ, ИСВ и КСОПВ на окружающую среду, и предоставит ее Членам;
- проведет работу с представителем каждого постоянного комитета и консультативной группы для обеспечения того, чтобы соответствующим группам были поручены последующие мероприятия касательно предлагаемой деятельности на 2026—2027 годы и далее и/или чтобы такие группы были созданы.

Г. Исследовательская группа по будущей инфраструктуре данных (ИГ-БИД)

Цель

В соответствии с [резолуцией 25 \(Кг-19\)](#) «Технический регламент Информационной системы ВМО 2.0» и в координации с Постоянным комитетом по управлению информацией и информационным технологиям (ПК-УИИТ) и Постоянным комитетом по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля (ПК-МПСЗ) Исследовательская группа по будущей инфраструктуре данных (ИГ-БИД) будет:

- а) стремиться обобщить технологические достижения в области обмена данными, в частности новые концепции, касающиеся данных на месте и интегрированных вычислений и сред данных; формулировать направления и возможности для Членов ВМО в этих предстоящих условиях, включая необходимость создания новых систем, основанных на данных;
- б) выявлять блокирующие факторы в сообществе и факторы, способствующие их устранению;

- c) изучать принципы устойчивости и бизнес-модели этих новых сред; и оценивать потребности в глобальных стандартах для работы с этими ожидающимися трансформационными технологиями и инфраструктурами;
- d) концентрировать эти исследования в контексте тех проблем, с которыми сталкиваются центры Комплексной системы обработки и прогнозирования ВМО (КСОПВ), включая региональные специализированные метеорологические центры (РСМЦ), региональные специализированные гидрологические центры (РСГЦ) и мировые метеорологические центры (ММЦ), спутниковых операторов и обслуживаемое ими сообщество.

Стремясь предвидеть потребности в развитии ключевой инфраструктуры КСОПВ и Информационной системы ВМО (ИСВ), Исследовательская группа будет осуществлять деятельность, связанную с четырьмя приведенными ниже областями, которые будут и далее уточняться в соответствии с меняющимся пониманием и требованиями:

- a) обзор и оценка технологических достижений в области обмена данными и потребностей: с помощью своих экспертов ИГ-БИД будет проводить оценку соответствующих достижений и изыскивать возможности для проверки их концепций в контексте существующей инфраструктуры ИСВ, чтобы понять существующие барьеры и варианты их устранения. ИГ-БИД будет работать на основе установленного набора сценариев использования, уточняя их по мере необходимости, экспериментируя с расширением концепций, таких как стандарты (форматы, ИПП, процесс обработки) и контейнеризация, а также другие новые актуальные концепции. К рассмотренным данным относятся наблюдения (в том числе путем дистанционного зондирования), входные данные модели (ассимиляция данных, модель, управляемая данными) и выходные данные (анализ, поля модели), а также данные обучения и выводы;
- b) сжатие данных на основе ИИ: в качестве подварианта технологического развития ИГ-БИД изучит возникающий потенциал выводов ИИ/МО в качестве механизма сжатия данных и их потенциальное использование в ходе будущего обмена данными;
- c) бизнес-модели и концепции: концепции «данные на месте» и приближенные вычисления данных (ПВД) связаны с потребностью в механизмах, позволяющих использовать эту инфраструктуру внешнему партнеру. С помощью заданного набора сценариев использования определяются конфигурации, которые необходимо документировать в частных и коммерческих облаках, а также в гибридных и объединенных средах. ИГ-БИД соберет примеры существующих технологий и механизмов в частном секторе, НМГС, спутниковых операторах и научных кругах, чтобы проинформировать ВМО и ее Членов о возможностях таких систем. Исследовательская группа не будет давать рекомендаций по принятию какой-либо бизнес-модели в рамках описанной здесь работы; тем не менее будет возможность сотрудничать с коммерческими поставщиками облачных услуг, которые уже имеют отлаженные механизмы хостинга и биллинга;
- d) стандарты и параметры: ИГ-БИД обобщит рекомендации трех вышеуказанных направлений относительно технических стандартов, позволяющих внедрять эти новые технологии, выявлять любые пробелы и содействовать возможностям в области разработки или совершенствования стандартов и профилей в более широком сообществе, например совместно с Открытым геопространственным консорциумом (ОГК, в контексте Меморандума о взаимопонимании ВМО/ОГК), в ходе своих экспериментов. В стандартах будут отражены вопросы контроля доступа и безопасности (аутентификация, разрешение на выполнение удаленного кода), проверки безопасности, расчета стоимости выполнения, а также эволюции параметров, обмен которыми происходит по мере появления моделей, основанных на данных.

Состав

В состав ИГ-БИД войдут до 15 экспертов, обладающих необходимыми экспертными знаниями и опытом в следующих областях, связанных с будущими технологиями обмена данными и их практической реализацией, включая представителей соответствующих постоянных комитетов ИНФКОМ и Совета по исследованиям:

- разработка и внедрение технологий и стандартов обмена данными в контексте больших данных, в том числе для спутниковых и других данных дистанционного зондирования;
- ИСВ и функции Центров ИСВ;
- КСОПВ и функции Центров КСОПВ;
- объединенные среды и среды приближенных вычислений данных, а также облачные среды;
- разработка машинного обучения применительно к сжатию и воспроизведению данных и/или моделей, основанных на данных;
- бизнес-модели и/или технические модели для размещения данных и вычислений.

ИГ-БИД возглавят сопредседатели, один из которых будет членом Группы управления ИНФКОМ.

Порядок работы

Одно очное совещание в течение следующего межсессионного периода, дополняемое перепиской по электронной почте и теле-/видеоконференциями.

Планируемые результаты

- Рекомендации в отношении трех направлений для рассмотрения на следующих этапах КСОПВ и ИСВ, которые должны быть представлены на четвертой сессии ИНФКОМ.
- Обзорная публикация о бизнес-моделях и концепциях.

Г. Исследовательская группа по оценке, назначению и обзору соответствия центров (ИГ-ОНОС)**Цель**

Учитывая результаты и уроки, извлеченные из пилотного аудита Регионального центра ИГСНВ (РЦИ), а также существующих процессов оценки, назначения и обзора соответствия для других типов центров, находящихся в ведении ИНФКОМ, включая региональные центры по приборам (РЦП), центры ИСВ и центры КСОПВ, Исследовательская группа по вопросам оценки, назначения и обзора соответствия центров (ИГ-ОНОС):

- 1) обеспечит толкование положений о демонстрации соответствия системы менеджмента качества и требований к аудиту в дополнении к части VII (1.4) [Технического регламента](#) (ВМО-№ 49), том I — Общие метеорологические стандарты и рекомендуемые практики, и представит проект поправок для уточнения положений, если это необходимо;

- 2) проведет оценку финансовой и оперативной осуществимости программы проведения аудиторской проверки РЦИ для всех РЦИ, которые будут назначены во всех регионах;
- 3) проанализирует возможность использования альтернативных механизмов оценки эффективности, таких как обратная связь с пользователями, ежегодные отчеты о положении дел, представляемые центрами, и статистика систем объективного мониторинга;
- 4) разработает проект общих принципов, касающихся процесса(ов) оценки, назначения и обзора соответствия центров, в том числе общих принципов сертификации и аккредитации, которые были бы финансово и оперативно осуществимы для всех типов центров, находящихся в ведении ИНФКОМ, в долгосрочной перспективе;
- 5) подготовит рекомендацию о подструктуре ИНФКОМ для поддержки разработки и осуществления процессов в соответствии с общими принципами.

Членский состав

В состав ИГ-ОНОС войдут до десяти экспертов, включая председателя, обладающих необходимыми экспертными знаниями и опытом для работы в следующих областях, связанных с функциями, процессом оценки, назначения и обзора соответствия центров, а также системами менеджмента качества:

- 1) функции и процесс оценки, назначения и обзора соответствия РЦИ;
- 2) функции и процесс оценки, назначения и обзора соответствия центров ИСВ;
- 3) функции и процесс оценки, назначения и обзора соответствия центров КСОПВ;
- 4) функции и процесс оценки, назначения и обзора соответствия РЦП, региональных центров по морским приборам (РЦМП), мировых и региональных радиационных центров (МРЦ и РНИЦ) и ведущих центров измерений (ВЦИ);
- 5) представители шести региональных ассоциаций, которых при необходимости поочередно сменяют технические координаторы Секретариата.

Порядок работы

Работа будет осуществляться по переписке по электронной почте и посредством проведения теле-/видеоконференций с возможностью проведения совещаний в очной форме, если президент сочтет это целесообразным и при условии наличия ресурсов.

Ожидаемые результаты

ИГ-ОНОС представит ИНФКОМ на ее четвертой сессии следующие результаты:

- 1) проект положений о демонстрации соответствия системы менеджмента качества и требований к аудиту в дополнении к части VII (1.4) *Технического регламента* (ВМО-№ 49), том I — Общие метеорологические стандарты и рекомендуемые практики, и проекты поправок для уточнения, если это потребуется;
- 2) отчет по итогам оценки осуществимости программы проведения аудиторской проверки РЦИ для всех потенциальных РЦИ, включая любые предложения по проекту корректировок, если это необходимо;

- 3) отчет по итогам анализа возможности использования альтернативных механизмов оценки эффективности, таких как обратная связь с пользователями, ежегодные отчеты о положении дел, представляемые центрами, и статистика систем объективного мониторинга;
- 4) проект общих принципов, касающихся процесса(ов) оценки, назначения и обзора соответствия центров, в том числе общих принципов сертификации и аккредитации, которые были бы финансово и оперативно осуществимы для всех типов центров, находящихся в ведении ИНФКОМ, в долгосрочной перспективе;
- 5) рекомендация о подструктуре ИНФКОМ для поддержки разработки и осуществления процессов в соответствии с общими принципами.

Н. Консультативная группа по Глобальной службе криосферы (КГ-ГСК)

Цель

Под руководством Группы управления Комиссии Консультативная группа по Глобальной службе криосферы (КГ-ГСК) будет выступать в качестве экспертного органа Комиссии по вопросам криосферы и обеспечивать надзор за разработкой и осуществлением программы работы и плана действий Комиссии, руководство ими, их координацию и мониторинг, уделяя особое внимание применению криосферных наук, а также охватывать соответствующую деятельность ВМО по Антарктике.

В частности, КГ-ГСК сосредоточится на оказании научно-технической поддержки в интеграции наблюдений за криосферой (in situ и дистанционное зондирование), управления данными, использования данных и прикладных аспектов криосферных наук в ИГСНВ, ИСВ и КСОПВ с целью обеспечения полностью совмещенной криосферы в системе Земля.

КГ-ГСК будет функционировать в рамках общего круга ведения консультативных групп и будет:

- a) предоставлять рекомендации Группе управления по вопросам, касающимся применения криосферных наук, путем преобразования сведений о потребностях Членов, полученных посредством регулярных консультаций, в рекомендуемую деятельность органов ИНФКОМ;
- b) консультировать Группу управления и постоянные комитеты по вопросам оптимальной рабочей структуры и привлечения экспертов в соответствующих подобластях для достижения конкретных ожидаемых результатов, предусмотренных программой работы ИНФКОМ, содействуя интеграции функций системы наблюдений, обмена данными, управления данными и прогнозирования в ИГСНВ, ИСВ и КСОПВ и обеспечивая при этом взаимовыгодное сотрудничество с международным экспертным сообществом;
- c) консультировать Группу управления по вопросам взаимодействия с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ), СИ, Группой экспертов Исполнительного совета по полярным и высокогорным наблюдениям, исследовательской деятельности и обслуживанию (ГЭИС-ПВНИДО), ССС, Координационной группой экспертов по гидрологии (КГЭГ) и региональными ассоциациями ВМО в сфере интеграции криосферной информации, например, для полярных и высокогорных районов и т. д.;
- d) при поддержке Секретариата ВМО и в сотрудничестве с соответствующими вспомогательными органами ИНФКОМ и СЕРКОМ, а также с СИ, готовить рекомендации для Группы управления и других органов по интеграции криосферы в

достижение целей Стратегического плана ВМО и ПО/Плана действий, уделяя особое внимание потребностям и синергии, как определено в [резолюции 6 \(КГ-19\)](#) и Стратегическом плане ВМО на 2024—2027 годы;

- e) устанавливать и поддерживать взаимовыгодные партнерские отношения и сотрудничество с соответствующими международными и научными органами, программами и сетями экспертов для содействия обмену знаниями о достижениях в области криосферных наук и для совместной деятельности;
- f) консультировать Группу управления и оказывать содействие вице-президенту, курирующему область криосферы, в вопросах взаимодействия с международным сообществом.

Членский состав

В состав КГ-ГСК в качестве основных членов будет входить до 15 экспертов.

Кроме того, КГ-ГСК будет включать в себя:

- a) представителей партнерских организаций на основе на текущих взаимовыгодных отношений;
- b) ассоциированных членов для обеспечения сбалансированной представленности всех компонентов криосферы — снега, морского и пресноводного льда, многолетней мерзлоты, ледников и ледяных шапок, ледяных щитов и шельфовых ледников, твердых осадков, — а также представленность криосферных наблюдений (приземных, дистанционного зондирования, спутниковых), управления данными, ассимиляции данных, моделирования и реанализа системы Земля, а также конкретных исследований и применений, как это предусмотрено планом работы ИНФОМ. Должны быть представлены все регионы ВМО.

КГ-ГСК будет возглавлять председатель и два заместителя председателя — члены Группы управления Комиссии.

Порядок работы

Одно очное совещание в межсессионный период (что соответствует 2-летнему циклу) в преддверии следующей сессии технической комиссии. В ином случае — посредством электронной переписки и проведения теле/видеоконференции.

Совещания или семинары, ориентирующиеся на конкретные результаты, как указано в программе работы Комиссии, будут координироваться и организовываться с соответствующими структурами и с участием соответствующих экспертов.

Ожидаемые результаты

Планируемые результаты приведены в соответствии с программой работы Комиссии.

I. Консультативная группа по океанам (КГ-Океан)

[КВ КГ-Океан соответствует приведенному в [дополнении к резолюции 2 \(ИНФОМ-2\)](#), будет пересмотрен в рамках корректировки системы управления]

Ж. Консультативная группа по гидрологии (КГ-Гидрология)

Цель

Под руководством Группы управления Комиссии Консультативная группа по гидрологии (КГ-Гидро) будет осуществлять надзор, координацию и мониторинг реализации инфраструктурного аспекта *Плана действий ВМО в области гидрологии*.

В частности, работа КГ-Гидро будет сосредоточена на интеграции гидрологического мониторинга в Интегрированную глобальную систему наблюдений ВМО (ИГСНВ) и Информационную систему ВМО (ИСВ), а также на использовании гидрологических данных и продукции в Комплексной системе обработки данных и прогнозирования ВМО (КСОПВ) для обеспечения полностью совмещенной гидрологии в рамках моделей системы Земля.

КГ-Гидро будет функционировать в рамках общего круга ведения консультативных групп, а также будет:

- a) выступать в качестве точки доступа для наблюдений, инфраструктуры и информационных систем в области гидрологии, включая пропаганду преимуществ использования подхода, основанного на системе Земля, и расширения участия экспертов;
- b) консультировать Группу управления по вопросам, связанным с гидрологическим мониторингом, путем преобразования потребностей гидрологического сообщества, информация о которых собрана через Координационную группу экспертов по гидрологии (КГЭГ), в предлагаемые мероприятия органов ИНФКОМ;
- c) осуществлять надзор, координацию и мониторинг реализации инфраструктурного аспекта *Плана действий* в координации с КГЭГ;
- d) консультировать Группу управления и постоянные комитеты по вопросам оптимальной рабочей структуры и привлечения экспертов в предметной области для обеспечения конкретных связанных с ИНФКОМ планируемых результатов, предусмотренных *Планом действий*, содействуя интеграции систем наблюдений, функций обмена данными и управления ими и прогнозирования в ИГСНВ, ИСВ и КСОПВ и обеспечивая при этом необходимую координацию действий экспертов в предметной области;
- e) консультировать Группу управления и оказывать помощь вице-президенту, представляющему соответствующую область, по вопросам взаимодействия через КГЭГ с региональными ассоциациями, Комиссией по обслуживанию и соответствующими внешними партнерами для обмена информацией о требованиях, планах работы и планируемых результатах для сохранения цикла формирования ценности в конкретных компонентах инфраструктуры в области гидрологии;
- f) консультировать по вопросам потребностей и приоритетов для развития потенциала в области гидрологии, связанного с ИНФКОМ, в том числе по вопросам обучения, Группу экспертов Исполнительного совета по развитию потенциала через координатора по развитию потенциала.]

Состав

В состав КГ-Гидро войдут порядка 15 экспертов, представляющих соответствующие экспертные группы всех постоянных комитетов Комиссии.

КГ-Гидро возглавят председатель и заместитель председателя, которые будут входить в состав Группы управления Комиссии.

Порядок работы

Большая часть работы будет осуществляться по переписке по электронной почте и посредством проведения теле-/видеоконференций с возможностью проведения совещаний в очной форме, если председатели сочтут это целесообразным и при условии наличия ресурсов.

Планируемые результаты

Планируемые результаты согласованы с программой работы Комиссии.

К. Координатор по осуществлению Единой политики ВМО в области данных (К-ДАТА)

Роль Координатора по вопросам политики в области данных (К-ДАТА) Комиссии по инфраструктуре заключается в контроле, координации и мониторинге хода осуществления Единой политики ВМО в области данных и распределении обязанностей, главным образом в рамках ИНФКОМ, но при необходимости в сотрудничестве с СЕРКОМ и СИ, для обеспечения осуществления Единой политики ВМО в области международного обмена данными о системе Земля (Единая политика в области данных) согласно [резолюции 1 \(Кг-Внеоч.\(2021\)\)](#). К-ДАТА будет работать с координационным механизмом Группы управления, состоящим из координатора, председателей или представителей постоянных комитетов и консультативных групп ИНФКОМ, а также, по мере необходимости, совместно спонсируемых систем наблюдения наряду с аналогичными представителями СЕРКОМ и СИ, чтобы обеспечить отображение необходимых задач и процессов в программах работы постоянных комитетов и их экспертных групп, а также обеспечить плавный переход от этапа осуществления к постоянной передовой практике международного обмена данными, интегрированной в технические и управленческие структуры ВМО.

Л. Координатор по развитию потенциала (К-РП)

Роль координатора по развитию потенциала при Комиссии по инфраструктуре заключается в том, чтобы в качестве основного связующего звена с Группой экспертов Исполнительного совета по развитию потенциала (ГЭРП) собирать информацию о текущей и планируемой деятельности по развитию потенциала групп ИНФКОМ, в том числе через назначенные глобальные и региональные центры и Фонд финансирования систематических наблюдений (ФФСН), а также поддерживать эффективное осуществление этой деятельности, руководствуясь Стратегией ВМО по развитию потенциала (СВРП). Целевая деятельность групп ИНФКОМ по развитию потенциала включает разработку основ компетенций и руководящих материалов, планирование и проведение тренингов и других мероприятий. К-РП будет работать с координационным механизмом, включающим координатора, координаторов по развитию потенциала постоянных комитетов и консультативных групп ИНФКОМ, при поддержке технических координаторов по инфраструктуре региональных бюро, чтобы обеспечить соответствие деятельности Комиссии в области развития потенциала нуждам и потребностям Членов, и предоставить ГЭРП рекомендации по нуждам и потребностям в развитии потенциала, а также опыт и возможности для использования в рамках мандата Комиссии.

Резолюция 4 (ИНФОМ-3)**Обновление Руководства по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1165)**

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 19 \(ИС-76\)](#) «Руководство по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1165)»,
- 2) [резолюцию 20 \(ИС-76\)](#) «Руководство по Глобальной опорной сети наблюдений»,
- 3) [резолюцию 47 \(Кг-19\)](#) «Обязательные публикации ВМО и политика в области распространения на девятнадцатый финансовый период»,

отмечая [рекомендацию 4 \(ИНФОМ-3\)](#) «Поправки к *Наставлению по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1160)»,

отмечая также, что Постоянным комитетом по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ) был рассмотрен проект обновления [Руководства по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1165),

изучив проект обновления [Руководства по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1165) в [дополнении](#) к настоящей резолюции,

принимает обновленное [Руководство по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1165), представленное в дополнении к настоящей резолюции;

порукает своей Группе управления обеспечить продолжение разработки и совершенствования Руководства посредством включения дополнительных материалов по мере его поступления;

предлагает Членам:

- 1) использовать Руководство при осуществлении ими соответствующих положений Технического регламента;
- 2) предоставлять ИНФОМ свои предложения относительно того, каким образом совершенствовать последующие версии Руководства;

призывает региональные ассоциации:

- 1) использовать Руководство при осуществлении ими соответствующих положений Технического регламента;
 - 2) предоставлять ИНФОМ свои предложения относительно того, каким образом совершенствовать последующие версии Руководства.
-

Дополнение к резолюции 4 (ИНФКОМ-3)

Обновление Руководства по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1165)

Guide to the WMO Integrated Global Observing System

PUBLICATION REVISION TRACK RECORD

<i>Date</i>	<i>Part/chapter/ section</i>	<i>Purpose of amendment</i>	<i>Proposed by</i>	<i>Approved by</i>
	<u>Chapter 1/1.2</u>	<u>Adding of Space weather.</u>	<u>INFCOM/SC-ESMP/ET-SWx</u>	
	<u>Chapter 1/1.3</u>	<u>Adjustments to reflect that WIGOS initial operational phase is over.</u>	<u>Secretariat</u>	
	<u>Chapter 2/2.1.4</u>	<u>Reference to WSI for satellites</u>	<u>INFCOM/SC-ON/ET-SSU</u>	
	<u>Chapter 3/3.1.2.2</u>	<u>Replace previous version of the GCOS Climate Monitoring principles with updated ones.</u>	<u>GCOS</u>	
	<u>Chapter 3/3.1.2.2</u>	<u>Text on OSCAR/Surface User manual expanded to accommodate Chapter 4 that was deleted</u>	<u>Secretariat</u>	
	<u>Chapter 3/Figure 3.3. and 3.43.1.2.2</u>	<u>Figure captions shortened</u>	<u>Secretariat</u>	
	<u>Chapter 4</u>	<u>Entire chapter was deleted and embedded in 3.1.2.2.</u>	<u>Secretariat</u>	
	<u>Chapter 5/5.2</u>	<u>Reference to WMO-No. 8 added under the OND Principle 5. Guidance on OND Principle 13 added</u>	<u>INFCOM/SC-MINT</u>	
	<u>Chapter 6/6.2.3.</u>	<u>Reference to WMO-No. 1197 added</u>	<u>INFCOM/SC-ON/ET-RFC</u>	
	<u>Chapter 6/6.2.5 and Annex 1</u>	<u>Addition of the section on Radio Frequencies (RF), including Terms of Reference on National Focal Points for RF matters</u>	<u>INFCOM/SC-ON/ET-RFC</u>	
	<u>Chapter 8/8.3.2.1</u>	<u>Reference to WMO-No. 1224 added</u>	<u>Secretariat</u>	

	Chapter 8/8.3.2.4	The role of RWC further explained by inclusion of relevant parts from WMO-No. 1224	Secretariat	
	Chapter 8/8.4.2.2	The minimum RWC technical infrastructure clarified by inclusion of relevant parts from WMO-No. 1224	INFCOM/SC-ON/ET-WTR	
	Chapter 8/8.4.3	RWC staff competences added by inclusion of relevant parts from WMO-No. 1224	INFCOM/SC-ON/ET-WTR	
	Chapter 9	Text referring to WMO-No. 1224 shortened and simplified	Secretariat	
	Chapter 10/10.7	Description of assignment of WSI for satellites	INFCOM/SC-ON/ET-SSU	
	Chapter 11/11.2.1	Reference to the guidance on the measurement of GBON variables added (WMO-No. 8)	Secretariat	
	Chapter 11/11.2.1/Table 11.1	Two new notes (43 and 45) added, as per interventions from Switzerland/SC-ON Chair and Japan, respectively.	Secretariat	
	Chapter 11/11.2.3	Clarification of the interpretation of the horizontal resolution provided	INFCOM/SC-ON/TT-GBON-Next	
	Chapter 11/11.3	Alignment with the new GBON design process as per Resolution 21 (Cg-19) and clarification of designation of marine stations	INFCOM/SC-ON/TT-GBON-Next	
	Chapter 11/11.4	Note on how Members compliance regarding marine stations/platform is considered	INFCOM/SC-ON/TT-GBON-Next	
	Chapter 11/11.4.2.2	Criteria for GBON marine station compliance criteria added	INFCOM/SC-ON/TT-GBON-Next	
	Chapter 11/11.4.3.1	Criteria for Member-level compliance GBON marine stations added	INFCOM/SC-ON/TT-GBON-Next	
	Chapter 11/11.4.3.2	Clarification of the Member-level compliance regarding coastlines	INFCOM/SC-ON/TT-GBON-Next	
	Chapter 11/11.4.4	Inclusion of OceanOPS to assist in alerting Members to non-compliance issues	INFCOM/SC-ON/TT-GBON-Next	
	Chapter 11/11.4.5	Clarification of the role of ad-hoc committee for claims invoking Article 9(b) exemptions	INFCOM/SC-ON/TT-GBON-Next	
	Chapter 11/11.5.1	Alignment of the roles with the updated GBON assignment process (11.3.1).	INFCOM/SC-ON/TT-GBON-Next	
	Chapter 11/11.7	Detailed guidelines on how to register, assign and remove GBON stations in OSCAR/Surface extracted	INFCOM/SC-ON/TT-GBON-Next	

		<i>for the Guide and included in OSCAR/Surface user manual.</i>		
	<i>Chapter 12.</i>	<i>Shortening the title and making it consistent with the title of the previous chapter</i>	<i>Secretariat</i>	
	<i>Chapter 12/12.3 and 12.4.</i>	<i>Alignment with the new process for GBON assignment as per Resolution 21 (Cg-19).</i>	<i>INFCOM/SC-ON /JET-ESODE</i>	
	<i>Chapter 12/ Annex 1 and Annex 2.</i>	<i>Reflection of Early Warning for All initiative, Resolution 4 (cg-19)</i>	<i>INFCOM/SC-ON /JET-ESODE</i>	

INTRODUCTION

General

This is the third edition of the *Guide to the WMO Integrated Global Observing System* (WMO-No. 1165). The Guide was developed following the decision of the Seventeenth World Meteorological Congress for the WMO Integrated Global Observing System (WIGOS) to proceed to a preoperational phase (2016–2019), as well as the approval by the Seventeenth Congress of the *Technical Regulations* (WMO-No. 49), Volume I, Part I, and the *Manual on the WMO Integrated Global Observing System* (WMO-No. 1160) (hereinafter, the “Manual on the WIGOS”). In essence, these two publications specify what is to be observed, as well as where, when and how, in order for Members to meet the relevant observational requirements.

To complement these activities, the Seventeenth Congress requested the Secretariat of the World Meteorological Organization (WMO) to publish a set of guidelines incorporated in an initial Guide, which would be progressively revised and enhanced through the WIGOS preoperational phase. The first edition of the *Guide to the WMO Integrated Global Observing System* (WMO-No. 1165) was approved by the Executive Council at its sixty-ninth session via Resolution 2 (EC-69) – Initial version of the Guide to the WMO Integrated Global Observing System.

Purpose and scope

~~The 2023 edition~~ This update of the Guide provides material relevant to some of the new WIGOS-related regulations, mainly related to: Resolution 1 (Cg-Ext(2021)) on the WMO Unified Policy for the International Exchange of Earth System Data and Resolution 2 (Cg-Ext(2021)) on the Global Basic Observing Network (GBON) (*World Meteorological Congress: Abridged Final Report of the Extraordinary Session (2021)* (WMO-No. 1281)); the Regional Basic Observing Network; a new Rolling Review of Requirements process; Regional WIGOS Centres; and the WIGOS station identifiers.

The Guide should be used in conjunction with the many other relevant WMO Guides, technical documents and related publications. For example, the *Guide to Instruments and Methods of Observation* (WMO-No. 8) is the authoritative reference for all matters related to instrumentation and methods of observation. It should be consulted for more detailed descriptions and best practices. The subsequent step of how observations are to be encoded and reported is specified in the *Manual on Codes* – International Codes (WMO-No. 306),

Volumes ~~I.1~~, I.2 and I.3. The *Guide to the Global Observing System* (WMO-No. 488) is the authoritative reference for all matters related to the Global Observing System.

Procedures for amending the Guide

The procedures for amending the present Guide can be found in the publication *Rules of Procedure for Technical Commissions* (WMO-No. 1240), Annex VII.

List of related publications

The development of the present Guide takes a thin-layer approach, meaning that it aims only to publish additional, new material that complements the material in existing Guides. All guidance relating to observing systems in any of the WMO Guides or Manuals is effectively WIGOS guidance material.

Below is the list of publications related to the *Guide to the WMO Integrated Global Observing System* (WMO-No. 1165). The most relevant are indicated by an asterisk (*) following the publication name. Publications are also referenced within sections of this Guide where there is a very specific point to be highlighted.

- (a) *Technical Regulations* (WMO-No. 49), Volumes I, II and III*
- (b) Manuals:
 - (i) *Manual on Codes – International Codes* (WMO-No. 306), Volumes ~~I.1 and I.2~~ and I.3
 - (ii) *Manual on the Global Telecommunication System* (WMO-No. 386)
 - (iii) *International Cloud Atlas: Manual on the Observation of Clouds and Other Meteors* (WMO-No. 407)
 - (iv) *Manual on the WMO Information System* (WMO-No. 1060)
 - (v) *Manual on the WMO Integrated Global Observing System* (WMO-No. 1160)*
- (c) Guides:
 - (i) *Guide to Instruments and Methods of Observation* (WMO-No. 8)*
 - (ii) *Guide to Climatological Practices* (WMO-No. 100)*
 - (iii) *Guide to Agricultural Meteorological Practices* (WMO-No. 134)
 - (iv) *Guide to Hydrological Practices* (WMO-No. 168), Volume I*
 - (v) *Guide on the Global Data-processing System* (WMO-No. 305)
 - (vi) *Guide to the Global Observing System* (WMO-No. 488)*
 - (vii) *Guide to the Implementation of Quality Management Systems for National Meteorological and Hydrological Services and Other Relevant Service Providers* (WMO-No. 1100)
 - (viii) *Guide to the WMO Information System* (WMO-No. 1061)
 - (ix) *Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology* (WMO-No. 1083), Volume I
 - (x) *Guide to Aircraft-based Observations* (WMO-No. 1200)

(d) Technical documents/technical notes:

- (i) *Baseline Surface Radiation Network (BSRN)*, Operations Manual, World Climate Research Programme Publication Series No. 121 (WMO/TD-No. 1274)
- (ii) *Guide to the GCOS Surface Network (GSN) and GCOS Upper-air Network (GUAN)*, GCOS Report No. 144 (WMO/TD-No. 1558; 2010 update of GCOS-73)
- (iii) *International Meteorological Tables* (WMO-No. 188, TP 94)*
- (iv) *Manual on Sea Level Measurement and Interpretation*, JCOMM Technical Report No. 31 (WMO/TD-No. 1339), Volume IV
- (v) *Note on the Standardization of Pressure Reduction Methods in the International Network of Synoptic Stations*, Technical Note No. 61 (WMO-No. 154, TP 74)
- (vi) *WMO Global Atmosphere Watch (GAW) Implementation Plan: 2016–2023*, GAW Report No. 228*

Note: The specifications provided in the referenced GAW implementation plan remain valid beyond the specified period of the plan.

(e) Guidelines and other related publications:

- (i) *WIGOS Metadata Standard* (WMO-No. 1192)
- (ii) *Technical Guidelines for Regional WIGOS Centres on the WIGOS Data Quality Monitoring System* (WMO-No. 1224)
- (iii) *Aircraft Meteorological Data Relay (AMDAR) Reference Manual* (WMO-No. 958)
- (iv) *GAW reports*
- (v) *The GCOS Reference Upper-air Network (GRUAN) – Manual*, WIGOS Technical Report No. 2013–02, GCOS Report No. 170
- (vi) *The GCOS Reference Upper-air Network (GRUAN) – Guide*, WIGOS Technical Report No. 2013–03, GCOS Report No. 171
- (vii) *Hydrology and Water Resources Programme (HWRP) manuals*
- (viii) JCOMM catalogue of practices and standards (WMO Manuals and Guides, and observation standards, such as manuals and guides of the Intergovernmental Oceanographic Commission)
- (ix) *Marine Meteorology and Oceanography Programme publications and documents*

1. INTRODUCTION TO THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM

1.1 PURPOSE AND SCOPE

It is specified in the *Technical Regulations* (WMO-No. 49), Volume I, Part I, and the Manual on the WIGOS that the WMO Integrated Global Observing System is a framework for all WMO observing systems and for WMO contributions to co-sponsored observing systems in support of WMO Programmes and activities.

1.2 WIGOS COMPONENT OBSERVING SYSTEMS

The component observing systems of WIGOS are the Global Observing System of the World Weather Watch Programme, the observing component of the Global Atmosphere Watch Programme, the WMO Hydrological Observing System of the Hydrology and Water Resources Programme and, the observing component of the Global Cryosphere Watch and the observing system for Space Weather, including their surface-based and space-based networks.

The above component systems include all WMO contributions to the co-sponsored systems, to the Global Framework for Climate Services and to the Global Earth Observation System of Systems. The co-sponsored observing systems are the Global Climate Observing System and the Global Ocean Observing System, both joint undertakings of WMO and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization, the United Nations Environment Programme and the International Science Council.

1.3 GOVERNANCE AND MANAGEMENT

Implementation and operation of WIGOS

The implementation of WIGOS is an integrating activity for all WMO and co-sponsored observing systems: it supports all WMO Programmes and activities. The Executive Council and regional associations, supported by their respective working bodies, have a governing role in the implementation of WIGOS. Technical aspects of WIGOS implementation are guided by the technical commissions, with leadership provided through the Commission for Observation, Infrastructure and Information Systems.

The WIGOS framework implementation phase occurred in the period 2012–~~2015~~. ~~Implementation plans and activities followed a structure based on ten key activity areas which are listed below and represented schematically in Figure 1.1:~~ ~~2019~~.

~~Figure 1.1. Ten key activity areas for the WIGOS framework implementation and how they relate~~

- ~~(a) Management of WIGOS implementation;~~
- ~~(b) Collaboration with the WMO co-sponsored observing systems and international partner organizations and programmes;~~
- ~~(c) Design, planning and optimized evolution;~~
- ~~(d) Observing system operation and maintenance;~~
- ~~(e) Quality management;~~
- ~~(f) Standardization, interoperability and data compatibility;~~
- ~~(g) The WIGOS Information Resource;~~
- ~~(h) Data discovery, availability (of data and metadata) and archiving;~~
- ~~(i) Capacity development;~~
- ~~(1) (j) Communications and outreach.~~

Building on the WIGOS framework, the ~~five priority~~ key areas ~~offor~~ the WIGOS ~~preoperational phase~~ operation and evolution, which support the delivery of the WMO strategic priorities, ~~are~~

~~being addressed in the period 2016–2019. The five priority areas~~ are listed below and are represented schematically in Figure 1.21:

- (2) ~~(a) Design, planning and optimized evolution of WIGOS by responding to the user requirements through the Rolling Review of Requirements process;~~
- (3) ~~Observing systems operation, maintenance, standardization, interoperability and data compatibility;~~
- (4) ~~Collaboration with the WMO cosponsored observing systems and international partner organizations and programmes;~~
- (5) ~~National WIGOS implementation, including necessary capacity development, partnership agreements and integration of observing systems for all application areas;~~

~~(b) WIGOS regulatory and guidance material;~~

- (6) ~~(c) Quality management, and fostering a culture of compliance with the WIGOS technical regulations;~~
- (7) ~~Implementation of the Global Basic Observing Network and the Regional Basic Observing Networks, as well as the Tiered Network approach;~~

~~Operation and evolution of the WIGOS Information Resource;~~

- (8) ~~(d) tools (WIGOS Data Quality Monitoring System (WDQMS), Observing Systems Capability Analysis and Review (OSCAR), Incident Monitoring System (IMS), etc.);~~
- (9) ~~(e) Operational implementation of the Regional WIGOS centres; Centres;~~
- (10) ~~Communications and outreach.~~

Figure 1.1.2: The **five key** priority areas of the WIGOS **preoperational phase operation and evolution**

2. WIGOS STATION IDENTIFIERS

2.1 FUNDAMENTALS

2.1.1 System of WIGOS station identifiers

The system of WIGOS station identifiers¹ is defined in the *Manual on the WIGOS*, Attachment 2.2.

The structure of a WIGOS identifier is:

WIGOS identifier series (number)	Issuer of identifier (number)	Issue number (number)	Local identifier (characters)

Only the WIGOS identifier series 0 has been defined. This series is used to identify observing stations.

¹ The expressions "WIGOS identifiers" or "WSI"/"WSIs" are used in this Guide as an abbreviation for "WIGOS station identifiers". The expression "observing station(s)" is also used as an abbreviation for "observing station(s)/platform(s)".

2.1.2 Principles of WIGOS identifiers

Each observing station must have at least one WIGOS identifier (WSI). A WSI can only be associated with one observing station. The station WIGOS identifier(s) link(s) the station to its WIGOS metadata.

WIGOS identifiers do not have meaning in themselves, so users must not interpret any patterns they see in these identifiers. Users should use the WMO global compilations of WIGOS metadata as the official sources, such as [OSCAR/Surface](#), to look up the metadata for the station associated with the identifier.

2.1.3 Recording the WIGOS identifier in observation reports (in the WMO standard reporting formats)

WIGOS identifiers cannot be represented in the traditional alphanumeric code forms, such as FM-12 SYNOP or FM-35 TEMP. The Table Driven Code Form equivalents have to be used (FM-94 BUFR or FM-95 CREX, or, in the future, model driven code forms). Further information on representing the WIGOS identifier in BUFR/CREX is available in [section 2.2](#).

Centres that are unable to process Table Driven Code Forms will not be able to access the reports from stations that have only WIGOS identifiers.

2.1.4 Assigning WIGOS identifiers to observing stations

The process for allocating a WIGOS identifier is illustrated in the figure [in this section 2.1](#).

Figure 2.1. Outline of procedure for allocating a WIGOS station identifier

Observing stations that had been allocated identifiers by a WMO Programme before the introduction of WIGOS identifiers (that is, before 1 July 2016) should continue to use those identifiers and are not required to have additional ones created for them. For these observing facilities, the WIGOS identifier can be deduced from the pre-existing identifier using the tables below. Further, should the station take on new responsibilities (such as an aviation station starting to report World Weather Watch synoptic information), the WIGOS identifier can also be used in that new context, even though it was derived from a WIGOS identifier associated with a different programme (in this example, the synoptic report could use the WIGOS identifier derived from the International Civil Aviation Organization (ICAO) location/airfield indicator²).

Although an observing station can have more than one WIGOS identifier, it is desirable to associate as few identifiers as possible with one station. Therefore, if an observing station is already associated with a WIGOS identifier, or is associated with an identifier issued by a WMO or partner programme, an additional WIGOS identifier should not be issued.

Only a WMO Member for which there is an [ISO 3166-1](#) numeric country code can assign its country code as the issuer of identifier value for its newly established observing stations. For example, the [Republic of Korea Meteorological Administration](#) can use "410" as the issuer of identifier number. This structure provides for an open range of station numbers that can be defined and allocated by the Republic of Korea to its expanding network (i.e. 0-410-0-XXXX).

For satellites, WIGOS station identifiers are assigned by WMO Space Programme, in collaboration with the entity responsible for the satellite (for example, a Member, a space agency or another owner of the satellite).

The WMO or partner programmes that were delegated with the authority to issue WIGOS identifiers (hereafter/thereafter referred to as "WSI issuers"), such as the Comprehensive

² The location indicators and their meanings are published in ICAO Location Indicators (Doc 7910).

Nuclear-Test-Ban Treaty Organization (CTBTO), as well as the relevant authority of Global Atmosphere Watch (GAW), Global Cryosphere Watch (GCW), and GCOS Reference Upper-air Network (GRUAN), may use specific issuer of identifier values for issuing WIGOS identifiers for observing stations that contribute to the relevant network on behalf of Members under circumstances specified in the Manual on the WIGOS.

Table 2.1 lists the issuer of identifier values that have been allocated for use for observing stations.

Table 2.1. Issuer of identifier values allocated for observing stations

<i>Range</i>	<i>Category of issuer</i>	<i>Allocation method</i>	<i>Procedures for assigning issue number and local identifier</i>
0	Reserved for internal use by OSCAR/Surface	OSCAR allocates the value	Determined by OSCAR/Surface
1–9999	Member State or Territory, for which there is an ISO 3166–1 numeric country code	Use of ISO 3166–1 three-digit numeric country code (by convention, leading zeroes are not shown in WIGOS identifiers). See the ISO website .	Issuer determines its own procedures. Further guidance is available in section 2.3 .
10000–10999	Member State or Territory, for which there is no ISO 3166–1 numeric country code	WMO Secretariat allocates an available number on request	Issuer determines its own procedures. Further guidance is available in section 2.3 .
11000–19999	Reserved for future use	To be determined	To be determined
20000–20999	WMO Secretariat, for existing identifiers previously associated with WMO Programmes (before 1 July 2016) – Exception is 20008 which applies to all GAW related stations	Details are provided in section 2.4.1 .	Details are provided in section 2.4.1 .
21000–21999	WMO Programmes, with delegated authority for new WIGOS identifiers ³	Details are provided in section 2.4.2 .	Details are provided in section 2.4.2 .
22000–22999	WMO co-sponsored programmes, for new WIGOS identifiers	Details are provided in section 2.4.3 .	Details are provided in section 2.4.3 .
23000–23999	WMO Partner Organizations/Programmes, for new WIGOS identifiers	Details are provided in section 2.4.4 .	Details are provided in section 2.4.4 .
24000–65534	Reserved for future use	To be determined	To be determined
65535	Missing value (reserved value in Table Driven Code Forms)		

2.2 WIGOS-ID-BUFR

This section explains how to represent the WIGOS identifier in WMO standard code forms.

³ That is, after 1 July 2016

2.2.1 Reducing ambiguity through systematic use of WIGOS identifiers

An observing facility may have several WIGOS identifiers. Using OSCAR/Surface, it is possible to discover all the WIGOS station identifiers associated with that facility. In theory, this allows any of the possible WIGOS identifiers to be used in a report of an observation, but in practice, doing so would result in a lot of additional work for all users of the observation. A disciplined approach to using WIGOS station identifiers in a report will reduce the work for end-users.

2.2.2 Choosing which WIGOS identifier to use

The following practices will make it easier for users of observation reports to link observations from a single observing facility:

- (a) Use the same WIGOS identifier for all reports of the same type from that observing facility. For example, always use the same identifier for surface synoptic reports;
- (b) If there is one, use the WMO Programme station identifier that is associated with the type of observation being reported to derive the WIGOS identifier. For example, a WIGOS identifier associated with the World Weather Watch land-station identifier would be used for surface synoptic reports;
- (c) There is no requirement to introduce new WIGOS identifiers if the observing facility already has one. For example, whatever type of observation is reported, if the facility has a WIGOS identifier derived from a World Weather Watch station identifier, then that WIGOS identifier may be used for reporting any type of observation. However, following practice (a) above, different types of reports might use different pre-existing identifiers.

2.2.3 Messages containing only reports from stations that have a pre-existing WIGOS identifier for the type of report being exchanged

In many cases, such as for surface observations from World Weather Watch land stations that existed before the introduction of WIGOS identifiers, no change is needed to report from those stations in BUFR or CREX. The existing identifier should be reported as in the past.

Nevertheless, it is good practice also to report the derived WIGOS identifier.

2.2.4 Messages containing reports from stations that do not have a pre-existing station identifier for the type of report being exchanged

New observing facilities, or those reporting new types of observations, will need to report the full WIGOS station identifier. BUFR and CREX messages that include reports from stations that do not have a pre-existing station identifier appropriate to that type of report have to include the BUFR/CREX sequence 3 01 150 to represent the WIGOS identifier.

If there is no pre-existing identifier, the value for the station identifier in the standard BUFR/CREX sequence should be set to the value representing "missing".

2.2.5 Reporting the WIGOS identifier in a BUFR/CREX message

When constructing a BUFR or CREX message that refers to WIGOS identifiers, the sequence 3 01 150 must appear in the message before the sequence describing the information from those stations.

That is, the message contents should be in the order:

< sequence for the WIGOS identifier (3 01 150)>
< sequence for the data being reported>

Additional guidelines on how to introduce the WIGOS identifier in BUFR and CREX messages

Where to place:

- (1) When Members report data using BUFR/CREX templates defined in the *Manual on Codes – International Codes* (WMO-No. 306), Volume I.2, Part C, section d, B/C Regulations or other BUFR/CREX sequences suitable for reporting specific data sets, and include the WSI, the sequence for reporting WSI (3 01 150) should be placed before the BUFR/CREX templates or other BUFR/CREX sequences in BUFR/CREX messages.

How to encode:

- (2) When Members report data from observation sites that have traditional station identifiers, such as a WMO block number (0 01 001)/WMO station number (0 01 002) and buoy platform identifier (0 01 005), these identifiers should also be reported in addition to corresponding WSI (3 01 150), to ensure the continuity of data use. On the other hand, the traditional station identifiers should be reported as “missing” when observation sites do not have the traditional identifiers.

Versions applicable:

- (3) BUFR/CREX messages that include the sequence for reporting WSI (3 01 150) should have master table version number 28 or later, because the sequence 3 01 150 is not defined in the tables with version numbers before 28.

Advanced notification:

- (4) Members should issue advanced notification at least three months before they start distributing new reports that include both traditional station identifiers and WSI (3 01 150), clearly stating the date of change, WSI, corresponding traditional station identifiers (when available), and new and existing bulletin headings. All Members will be notified of these changes through METNO messages defined by the *Manual on the Global Telecommunication System* (WMO-No. 386) and as an entry of the [Operational Newsletter](#).

Distribution not parallel:

- (5) Parallel distribution of BUFR/CREX messages with and without WSI (3 01 150), which consists of the same contents, is discouraged, as the messages coded in conformity with the practice in (2) above satisfies user requirements, and duplicated reporting of the same contents could cause confusion for users.

2.2.6 Reporting the WIGOS identifier when the reporting environment can only handle traditional alphanumeric codes

Traditional alphanumeric code forms cannot represent WIGOS identifiers. Furthermore, observations can only be exchanged in traditional alphanumeric code if the observing facility has been allocated a conventional World Weather Watch station identifier. Observation facilities that have not been allocated a World Weather Watch station identifier must exchange their observations using the Table Driven Code Forms.

In some circumstances, however, it may be necessary to report observations internationally from stations that do not have a pre-existing World Weather Watch station identifier and for which the technical environment only supports the traditional alphanumeric codes.

The recommended approach in this case is to agree on a national practice that meets the local technical constraints to identify the observing station in reports (or a bilateral practice where an arrangement is made to translate traditional alphanumeric code to Table Driven Code

Format for international exchange). These national reports must be converted to Table Driven Code Format before the international exchange; the conversion must include a translation from the method of identifying the station used in the national report to the WIGOS identifier for that station. Extreme care must be taken to ensure that the national report is not distributed internationally.

Examples of a possible national practice for a surface synoptic report might be to use five alphabetic characters for the identifier, or a numeric identifier in the range 99000 to 99999 (only two identifiers in that range, 99020 and 99090, were recorded in [Weather Reporting](#) (WMO-No. 9), Volume A, in July 2016). A look-up table from that identifier to the WIGOS identifier would allow the translating centre to insert the WIGOS identifier.

The situation is more complex for upper-air reports. In this case, the WMO Secretariat should be asked for assistance.

2.3 RECOMMENDED PRACTICES FOR THE ALLOCATION OF ISSUE NUMBER AND LOCAL IDENTIFIER

Members are recommended to develop their national schema for assigning WSIs with agreed procedures for allocating the issue number and local identifier, taking into account their national organizational structure and requirements. A WSI national schema may define specific ranges (for the issue number) for delegating national authority for issuing WSIs to identified organizations for the observing facilities they operate. It may also define procedures for the allocation of local identifiers. Members may decide whether the implementation and maintenance of the national schema for allocating WSIs is centrally managed by a single organization or is distributed across various national organizations receiving delegated ranges for assigning WSIs, via the issue number.

2.3.1 Allocating WIGOS identifiers

- (a) Issuers of identifiers are responsible for guaranteeing that no two observing stations share the same WIGOS identifier. Note that the structure of WIGOS identifiers guarantees that issuers cannot create identifiers that have already been allocated by another issuer.
 - (i) Issuers of identifiers may choose to use the issue number to allow them to delegate the task of allocating local identifiers to other organizations responsible for managing individual observing networks. Assigning each organization a different issue number will allow those organizations to allocate local identifiers for their observing facilities.
 - (ii) The issuer of identifiers has to record which issue numbers have been allocated and which organization is responsible for managing local identifiers for each.
- (b) An organization issuing local identifiers (and issue numbers if it has not had one assigned to it) must ensure that no two observing facilities share the same WIGOS identifier.
 - (i) When issuing the local identifier:
 - a. If the organization is responsible for allocating both issue numbers and local identifiers, it must ensure that no two observing facilities have the same combination of issue number and local identifier.
 - b. If the organization is only responsible for allocating local identifiers then it is sufficient for it to ensure that it does not assign the same local identifier to more than one observing facility.
 - (ii) The organization must maintain a record of the local identifiers (and issue numbers) it has allocated (it may choose to use OSCAR for this).

- a. The organization may choose to use an existing national identifier as the local identifier for the observing facility. Doing so in a systematic way may decrease its administrative load.
 - b. Historically, station identifiers may have been reused when observing facilities closed and new ones opened. If the organization has been allocated a range of issue numbers, it may wish to consider using different issue numbers to distinguish between the different locations, allowing the local identifier to retain the link to the other location.
 - c. Although a single WIGOS identifier must not be issued to more than one observing facility, it is permitted for a station to have more than one WIGOS identifier. For example, although all observing facilities with pre-existing World Weather Watch station identifiers have a WIGOS identifier based on the World Weather Watch identifier, the organization may wish to create a new identifier that is linked to a national numbering scheme.
 - d. The WIGOS identifier for a closed observing facility must not be reused unless the observing facility reopens.
- (iii) The organization responsible for allocating the WIGOS identifier should ensure that the operator of the observing facility has committed to providing and maintaining WIGOS metadata for that facility.
- a. In cases where a station has more than one WIGOS identifier, the organization issuing the local identifier should associate all these station identifiers with the same WIGOS metadata record so that only one WIGOS metadata record needs to be maintained. OSCAR will provide tools to document this linkage.
 - b. If a fixed observing facility is moved, the organization should consider whether it should be issued a new WIGOS identifier, whether the WIGOS metadata should be updated to state that the observing facility at the previous position has closed and whether a new WIGOS metadata record should be created for the new location. The organization must use meteorological judgement on the impacts of the change in deciding whether to retain the WIGOS identifier or to issue a new one. A move of a few metres is unlikely to be significant, but a move to the opposite side of a mountain would be treated as a new station.

Note: The structure of the WIGOS identifier means that the range of WIGOS identifiers is, for practical purposes, unlimited. This removes the need to reuse WIGOS identifiers.

- (c) Before issuing a WIGOS identifier, it is important to search [OSCAR/Surface](#) to make sure that it has not already been allocated, and to register that WSI in OSCAR/Surface first, before exchanging any reports with such WSI.
- (d) Members and organizations issuing WIGOS identifiers are strongly advised to document their procedures for allocating WIGOS identifiers in their quality management systems.

2.3.2 Specifying the local identifier

The local identifier may be up to 16 characters long. It must not contain or be preceded by blanks, and any blanks added to the end of the identifier by IT systems must be ignored.

The local identifier may contain only alphanumeric characters. These are a set of 62 characters including all the uppercase and lowercase letters from a to z and all the digits from 0 to 9. Symbols and special characters are not allowed in the set of alphanumeric characters to be used for the local identifier.

Leading zeroes in a local identifier are significant and must be treated as part of the character string. (Note that this differs from the treatment of leading zeroes in the issuer of identifier and issue number parts of the WIGOS identifier, which are omitted from the WIGOS identifier.)

Example 1

- (a) Consider a Member that has observing systems managed by many different organizations, including the National Meteorological Service (NMS), the National Hydrological Service (NHS) and the National Transport Department. Each of these organizations is independent, and each has its existing conventions for labelling observing facilities. For example, the Meteorological Service uses WMO World Weather Watch station identifiers for its synoptic network, its own numbering system for other weather observing facilities, and another numbering system for its climate observing facilities.
- (b) In this situation, the Member (as an issuer of identifiers) might choose to use the following convention for assigning WIGOS identifiers. In all cases, if an observing facility is closed its local identifier must not be re-attributed (with the same issue number).

<i>Issue number</i>	<i>Interpretation of issue number</i>	<i>Local identifier</i>
1	NMS synoptic observing facility	WMO World Weather Watch station identifier (with leading zeroes if necessary to make it five characters long). Initially, to ensure that plotting software can display local identifiers, the Member chooses to limit their length to five characters and to assign to new WIGOS identifiers that lie outside the block of identifiers allocated to the Member by the World Weather Watch.
2	NMS other weather observing facility	Existing national station identifier (with leading zeroes if necessary). The local identifier for a new observing facility is created using the existing procedures for national station identifiers.
3	NMS climate observing facility	Existing climate station identifier (without leading zeroes, as that was the convention for climate observing facility identifiers in the past). New observing facilities are allocated identifiers using the existing practices.
100–200	Used by NHS for allocating identifiers for its observing facilities. The NHS allocates one number to each of its regions. The NHS is organized according to river basins, and it uses its range of issue numbers to subdelegate the allocation of local identifiers to each river basin authority.	The NHS uses its existing river basin observing facility numbering system.
1000–10000	Used by the National Transport Department for allocating its observing facility identifiers. Each road has its own issue number.	Derived from the distance of travel along a road when travelling away from the national capital before reaching the observing facility.

Example 2

- (a) A Member has implemented a national system for managing its national assets. Each observing facility has to be registered on this system and as a consequence has been allocated an asset number used to track all information about the facility. Some of these

assets are mobile platforms (such as moored buoys). Disposable observing platforms (such as radiosondes) are associated with the asset number of their base station.

- (b) The Member wishes to align its WIGOS identifiers with its national asset management system. It chooses to use the national asset number as the local identifier. The Member is concerned that it may move assets from one location to another. In consequence, the Member uses the issue number to record changes in location. Because it wishes to record past positions as well, it decides initially to use an issue number of 10000 and to increment it for an asset every time that asset is re-deployed. It uses issue numbers less than 10000 to record historical positions for that asset. By doing this, the Member ensures that the asset number will not result in misleading WIGOS metadata histories and the link to the asset number will be maintained.

2.4 ALLOCATING ISSUERS OF IDENTIFIERS FOR OBSERVING STATIONS

This section explains how to allocate issuers of identifiers for observing stations associated with WMO Programmes.

2.4.1 WMO Secretariat for existing identifiers previously associated with WMO Programmes (before 1 July 2016)

Table 2.2 defines the issuer of identifier values in the range 20000–20999 to be used for WMO Programmes to issue WIGOS identifiers. This range is used to ensure that observing facilities that have pre-existing station identifiers can be allocated a WIGOS identifier in a way that retains an association with the pre-existing identifier. Any new observing facility will be given an identifier within the range allocated to the Member operating the observing facility (station/platform). Otherwise, WSI issuers, with delegated authority, will allocate a WIGOS identifier to any new observing facility that contributes to the relevant network, on behalf of Members, following provisions documented in the Manual on the WIGOS. Sections 2.4.1–2.4.4 of this Guide define the ranges of values for WSI issuers for stations associated with WMO co-sponsored programmes and WMO partner programmes.

Table 2.2. Issuer of identifier values in the range 20000–20999

<i>Issuer of identifier values</i>	<i>Category of station identifier</i>	<i>Issue number</i>	<i>Local identifier</i>
20000	World Weather Watch land-station with sub-index number (SI) = 0	0: station defined in <i>Weather Reporting</i> , Volume A, on 1 July 2016 Any other positive number: to distinguish between different observing facilities that used the same station identifier in the past	Use the block number II, and the station number iii, as a single five-digit number Iiii (with leading zeroes). Example: station 60351 would be represented by 0–20000–0–60351
20001	World Weather Watch land-station with sub-index number (SI) = 1	0: station defined in <i>Weather Reporting</i> , Volume A, on 1 July 2016 Any other positive number: to distinguish between different observing facilities that used the same station identifier in the past	Use the block number II, and the station number iii, as a single five-digit number Iiii (with leading zeroes). Example: upper-air station 57816 would be represented by 0–20001–0–57816
20002	World Weather Watch marine platform (moored	0: platform for which the identifier was in use on 1 July 2016	Use the region/platform number combination

<i>Issuer of identifier values</i>	<i>Category of station identifier</i>	<i>Issue number</i>	<i>Local identifier</i>
	or drifting buoy, platform, etc.)	Any other positive number: to distinguish between different platforms that used the same identifier at different times	A1bwnbnbnb. Example: The data buoy 59091 would be represented by 0-20002-0-59091 The World Weather Watch list of data buoys has two buoys with identifier 13001. The buoy most recently used at the time WIGOS identifiers were introduced is allocated 0-20002-0-13001 and the second is issued identifier 0-20002-1-13001.
20003	Ship identifier based on the International Telecommunication Union call sign	0: ship to which the identifier was most recently allocated on 1 July 2016 Any other positive number: to distinguish between different ships that used the same ship identifier at different times	Ship call sign Example: the (now obsolete) weather ship C7R would be represented by 0-20003-0-C7R
20004	Ship identifier – issued nationally	0: ship to which the identifier was most recently allocated on 1 July 2016 Any other positive number: to distinguish between different ships that used the same ship identifier at different times	Ship identifier Example: the fictitious ship XY123AB would be represented by 0-20004-0-XY123AB
20005	AMDAR aircraft identifier	0: aircraft to which the identifier was most recently issued on 1 July 2016 Any other number: to distinguish between different aircraft that used the same aircraft identifier at different times	Aircraft identifier Example: aircraft EU0246 would be represented by 0-20005-0-EU0246
20006	ICAO airfield identifiers	0: airfield to which the identifier was most recently allocated on 1 July 2016 Any other positive number: to distinguish between airfields that used the same airfield identifier at different times	ICAO airfield identifier Example: Geneva airport (LSGG) would be represented by 0-20006-0-LSGG
20007	International Maritime Organization (IMO) ship number (hull number)	0: ship to which the IMO number was most recently allocated on 1 July 2016 Any other positive number: to distinguish between ships that used the same IMO identifier at different times	Ship identifier Example: ship 9631369 would be represented by 0-20007-0-9631369

<i>Issuer of identifier values</i>	<i>Category of station identifier</i>	<i>Issue number</i>	<i>Local identifier</i>
20008	Global Atmosphere Watch (GAW) identifier	0: station to which the GAW identifier was most recently allocated on 1 July 2016	Three-character GAW identifier Example: Jungfrauoch JFJ would be represented by 0-20008-0-JFJ
20009	WMO Satellite Programme	0	Three-digit satellite identifier with leading zeroes (recorded in Common Code table C-5 of the Manual on Codes – International Codes (WMO-No. 306), Volume I. 12) Example: METEOSAT 10 (with identifier 057) would be represented by 0-20009-0-057
20010	WMO Weather Radar	0	Unique key used to cross-reference information about a single radar within the WMO Radar Database (this key was not previously published) Example: Station with record number 121 would be represented by 0-20010-0-121
20011–20999	Reserved for future use	To be determined	To be determined

2.4.2 WMO Programmes with delegated authority for new WIGOS identifiers (after 1 July 2016)

Table 2.3 defines the issuer of identifier values in the range 21000–21999 to be used for WIGOS identifiers.

Table 2.3. Issuer of identifier values in the range 21000–21999

<i>Issuer of identifier values</i>	<i>Category of station identifier</i>	<i>Issue number</i>	<i>Local identifier</i>
21000	Identifiers for GCW – See 10.1		
20008	GAW – See 10.3 (as an exception, the issuer of identifier for GAW stations is not within the range 21000–21999)		
21010	WRD – See 10.4		
21011	WMO Aircraft-based Observations Metadata Repository (ABO-MR) – See Guide to Aircraft-based Observations (WMO-No. 1200), Appendix D	To be determined	Issued by the ABO-MR in accordance with Guide to Aircraft-based

			Observations (WMO-No. 1200)
21016	WHOS – See 10.6		
Remaining values in the range 21000–21999	Reserved for future use	To be determined	To be determined

2.4.3 WMO co-sponsored programmes for new WIGOS identifiers

Table 2.4 defines the issuer of identifier values in the range 22000–22999 to be used for WIGOS identifiers.

Note: No issuer of identifier number in this range has yet been issued.

Table 2.4. Issuer of identifier values in the range 22000–22999

<i>Issuer of identifier values</i>	<i>Category of station identifier</i>	<i>Issue number</i>	<i>Local identifier</i>
22000	GOOS – Identifiers for marine systems administered through ~~OCEANOPS~~ OceanOPS – See 10.2 Note: ~~OCEANOPS~~ OceanOPS coordinates some marine observing systems to avoid technical incompatibilities.	Determined by ~~OCEANOPS~~ OceanOPS	Determined by ~~OCEANOPS~~ OceanOPS
22001	GRUAN		
22002–22999	Reserved for future use	To be determined	To be determined

2.4.4 WMO Partner Organizations/Programmes for new WIGOS identifiers

Table 2.5 defines the issuer of identifier values in the range 23000–23999 to be used for WIGOS identifiers.

Table 2.5. Issuer of identifier values in the range 23000–23999

<i>Issuer of identifier values</i>	<i>Category of station identifier</i>	<i>Issue number</i>	<i>Local identifier</i>
23000	CTBTO		
23001	Copernicus-C3S		
23002–23999	Reserved for future use	To be determined	To be determined

2.4.5 Observing programmes/networks that do not have an international system for station identification

The following observing programmes/networks do not have a pre-existing international system for assigning WIGOS identifiers and have not been allocated issuers of identifiers. Members operating the stations supporting these observing programmes should allocate WIGOS identifiers using their national system.

Global Sea-level Observing System: WIGOS identifiers have been issued according to national conventions. In cases where the identifier of another WMO Programme has been used (for example, a land-station identifier), the WIGOS identifier corresponding to that Programme identifier should be used.

Global network of tsunameters: WIGOS identifiers are issued according to national conventions. In cases where the identifier of a WMO Programme has been used (for example, a land-station identifier), the WIGOS identifier corresponding to that Programme identifier should be used.

3. WIGOS METADATA

3.1 INTRODUCTION

The availability of WIGOS metadata is essential for the effective planning and management of WIGOS observing systems. These metadata are also crucial for the Rolling Review of Requirements process and similar activities at national level.

WIGOS metadata are interpretation/description or observational metadata, that is, information that enables data values to be interpreted in context and permits the effective utilization of observations from all WIGOS component observing systems by all users.

The WMO Information System (WIS) is the single coordinated global infrastructure responsible for telecommunications and data management functions. WIS enables: (i) routine collection and dissemination of time-critical and operation-critical data and products; (ii) data discovery, access and retrieval; and (iii) timely delivery of data and products. WIGOS metadata give insight into the conditions and methods used to make the observations that are distributed through the WIS.

WIGOS metadata describe the station/platform where the observation was made, the system(s) or network(s) the station/platform contributes to, the instruments and methods of observations used and the observing schedules, in order to support planning and management of WIGOS observing systems.

WIGOS metadata also describe the observed variable, the conditions under which it was observed, how it was measured or classified and how the data have been processed, in order to provide the users with confidence that the use of the data is appropriate for their application. The Global Climate Observing System Climate Monitoring Principle (e5) describes the relevance of metadata as follows:

~~The~~In order to ensure the utility of the observations, the details and history of local conditions, site location, instruments, operating procedures, data processing algorithms, data errors and biases, and other factors pertinent to interpreting data (i.e. for example, metadata) and their changes over time should be documented and treated with the same care as the data themselves. (~~The Global Observing System for Climate: Implementation Needs (GCOS-200), Box 8)~~

Metadata can be static, for example the exposure of an instrument at a fixed station. Metadata can change with every observation, for example the location of a mobile station, in which case the metadata should be reported with the observations to which they apply.

The WIGOS Metadata Standard specifies the metadata elements that exist and that are to be recorded and made available. More information about the Standard can be found in the Manual on the WIGOS and the *WIGOS Metadata Standard* (WMO-No. 1192). The Standard has been implemented in [OSCAR/Surface](#), which is the WMO official authoritative repository of metadata on surface-based meteorological, climatological, hydrological and other related environmental observations that are required for international exchange. OSCAR/Surface is one of the components of the WIGOS Information Resource.

Observational metadata are to be submitted to and maintained in OSCAR/Surface by WMO Members, and in [OSCAR/Space](#) by relevant WMO Members according to the provisions of the Manual on the WIGOS. Metadata from a number of co-sponsored observing systems are also

maintained in OSCAR. OSCAR/Surface replaces and significantly extends Weather Reporting (WMO-No. 9), Volume A. It highlights the much wider scope of all the WIGOS component observing systems.

This chapter provides guidance on recording metadata related to surface-based observations and submitting those to OSCAR/Surface.

3.1.1 Key terminology

Measurand. Quantity intended to be measured ([International Vocabulary of Metrology – Basic and General Concepts and Associated Terms \(VIM\)](#), JCGM 200:2012).

Note: Generally, it is the result of a measurement from an instrument.

Observation. The evaluation of one or more elements of the physical environment (*Technical Regulations* (WMO-No. 49), Volume I).

Note: It is the act of measuring or classifying the variable. The term is also often used to refer to the data resulting from the observation, even though the term “observational data” is defined as the result of an observation (*Technical Regulations* (WMO-No. 49), Volume I).

Observational data. The result of the evaluation of one or more elements of the physical environment.

Observational metadata. Descriptive data about observational data and/or observing stations/platforms: information that is needed to assess and interpret observations or to support design and management of observing systems and networks (*Technical Regulations* (WMO-No. 49), Volume I).

Observed variable. Variable intended to be measured (measurand], observed or derived, including the biogeophysical context” (*WIGOS Metadata Standard* (WMO-No. 1192)).

Observing domain. The component of the Earth system which is being observed: atmospheric (over land, sea, ice), oceanic and terrestrial.

Observing facility. An alternative term for “observing station/platform”.

Observing network. More than one observing station/platform, acting together to provide a coordinated set of observations” (*Technical Regulations* (WMO-No. 49), Volume I).

Observing site Also a term for a place where observations are made. However, it is generally used when taking into account the environmental conditions of the location.

Observing station/platform. A place where observations are made; this refers to all types of observing station and platform, whether surface-based or space-based, on land, sea, lake or river, or in the air, fixed or mobile, and making in situ or remote observations, using one or more sensors, instruments or types of observation (*Technical Regulations* (WMO-No. 49), Volume I). In many contexts this is abbreviated to “station”.

Observing system. One or more stations/platforms, acting together to provide a coordinated set of observations (*Technical Regulations* (WMO-No. 49), Volume I).

3.1.2 Managing WIGOS metadata in accordance with the WIGOS Metadata Standard

3.1.2.1 Identification of functions and responsibilities

The following generic national functions and responsibilities need to be fulfilled:

- (a) Network metadata manager: responsible for keeping network observational metadata up to date, correct, quality controlled and complete;
- (b) Observational metadata manager: responsible for encoding and transmitting WIGOS metadata and ensuring that metadata meet the Standard;
- (c) Station/platform metadata maintainer: responsible for recording and maintaining metadata for the station/platform.

The above labels might not be used, but the relevant functions need to be fulfilled.

3.1.2.2 Using the OSCAR/Surface tool

The key WMO tool to assist in the above functions is the OSCAR ~~surface-based capabilities database~~/Surface, which is the WMO official repository of WIGOS metadata for surface-based observing stations and platforms.

The WIGOS Metadata Standard, for surface-based observations is implemented through the OSCAR/Surface tool, which means that Members must transfer their WIGOS metadata, either in near-real time or less frequently, to OSCAR/Surface for the observations they exchange internationally. All prescribed metadata are to be collected and stored by Members. Moreover, OSCAR/Surface contains a few additional metadata fields not explicitly specified in the Standard, such as population density. Members should include as many of the additional fields as possible in OSCAR/Surface.

Note that OSCAR/Surface provides an interface for the manual submission of metadata. This interface is accessed through the Internet using any web browser. Machine-to-machine submission of metadata is now also possible.

~~Further guidance on using OSCAR/Surface is provided in HYPERLINK: Paragraph <Chapter 4> of this Guide.~~

Detailed guidance on how to use OSCAR/Surface is provided in the OSCAR/Surface User Manual, which is available at <https://oscar.wmo.int/surface/> and in the WMO library. The OSCAR/Surface User Manual comprises two main sections:

- Section 2. Finding information in OSCAR/Surface contains guidance on how to search the database to find stations and information about available observations – this section is useful for both registered and anonymous users;
- Section 3. Changing information in OSCAR/Surface contains information on how to manage stations in the database – this section is relevant mainly for registered users, such as station contacts and national focal points.

3.2 GENERAL GUIDANCE ON WIGOS METADATA

The WIGOS Metadata Standard is an observation-focused standard. However, typically observations are grouped in terms of the observing station/platform where one or more sensors or instruments are located.

The following metadata elements of the Standard are mandatory. The initial numbers refer to the elements in the Standard and the numbers in brackets refer to sections of this chapter:

- 1–01 Observed variable – measurand (3.2.2)
- 1–03 Temporal extent (3.2.1, 3.2.2)
- 1–04 Spatial extent (3.2.2 and 3.3.1)
- 2–02 Programme/network affiliation (3.2.1 and 3.2.2)
- 3–03 Station/platform name (3.2.1)

- 3-04 Station/platform type (3.2.1)
- 3-06 Station/platform unique identifier (3.2.1)
- 3-07 Geospatial location (3.2.1, 3.2.1.1, 3.3.1 and 3.3.1.2)
- 3-09 Station operating status (3.2.1)
- 5-01 Source of observation (3.2.2)
- 5-02 Measurement/observing method (3.2.2)
- 6-08 Schedule of observation (3.2.2)
- 7-03 Temporal reporting period (3.2.2)
- 7-14 Schedule of international exchange (3.2.2)
- 9-01 Supervising organization (3.2.1 and 3.2.2)
- 9-02 Data policy/use constraints (3.2.2)
- 10-01 Contact (nominated focal point) (3.2.3)

The following metadata elements of the Standard are mandatory when relevant conditions are met (they are referred to as conditional elements):

- 1-02 Measurement unit (3.2.2)
- 3-01 Region of origin of data (3.2.1 and 3.3.1.1)
- 3-02 Territory of origin of data (3.2.1 and 3.3.1.1)
- 4-02 Surface cover classification scheme (3.2.2)
- 5-05 Vertical distance of sensor (3.2.2 and 3.3.1.1)
- 5-06 Configuration of instrumentation (3.2.2)
- 5-08 Instrument control result (3.2.2)
- 5-12 Geospatial location (3.2.1.1, 3.2.2, 3.2.2.1 and 3.3.1.2)
- 5-15 Exposure of instruments (3.2.2)
- 6-07 Diurnal base time (3.2.2)
- 7-04 Spatial reporting interval (–)
- 7-11 Reference datum (3.2.2 and 3.3.1.1)
- 8-02 Procedure used to estimate uncertainty (3.2.2 and 3.3.1.4)
- 8-04 Quality flagging system (3.2.2 and 3.3.1.4)
- 8-05 Traceability (3.2.2 and 3.3.1.4)

In OSCAR/Surface, metadata are assembled under five headings, one for each subsection below (3.2.1–3.2.5).

Notes:

1. Each time the number in format x-yy appears in this Guide, it refers to the number of the metadata element in the WIGOS Metadata Standard. Where a metadata element is mentioned without this number, it means it is not part of the Standard.
2. Users of OSCAR/Surface may or may not see certain fields when navigating the various stations in the database depending on whether the field was filled out when the station was created/edited.

3.2.1 Station characteristics

Under this heading, the basic information about the station/platform with the following mandatory elements can be found: name (3-03 Station/platform name), date established (1-03 Temporal extent), station type (3-04 Station/platform type), WIGOS station identifier (3-06 Station/platform unique identifier), WMO Region (3-01 Region of origin of data), country/territory (3-02 Territory of origin of data), coordinates, that is to say, the latitude, longitude, elevation and geopositioning method used (3-07 Geospatial location), 9-01 Supervising organization, and 2-02 Programme/network affiliation (for the station, including the declared status (3-09 Station operating status)).

Under this heading, some elements that are not mandatory can be found, such as those describing the relevant environmental characteristics of the station/platform and its surroundings: 4-07 Climate zone, predominant surface cover (4-01 Surface cover), 4-06 Surface roughness, 4-03 Topography or bathymetry, station/platform events/logbook (4-04 Events at observing facility) and site description (4-05 Site information) with possible images

(photo gallery) of the station/platform; OSCAR/Surface has used this last field to capture legacy remarks from *Weather Reporting* (WMO-No. 9), Volume A.

Complementary information that can be inserted under station characteristics that does not correspond to any metadata elements of the Standard includes: station alias, station class(es), Time zone, station URL (a reference/address for a resource on the Internet), Other link (URL), and population per 10 km²/50 km² (in thousands).

3.2.1.1 Station coordinates

The method to specify station coordinates (3–07 Geospatial location) is described in the *Guide to Instruments and Methods of Observation* (WMO-No. 8), Volume I, Chapter 1, 1.3.3.2.

Figure 3.1 shows the various metadata elements related to the station's geospatial location (3-07) versus the instrument's geospatial location (5–12), and their references for the height.

Figure 3.1. Metadata elements for station location and instrument location, including height references

3.2.2 Observations/measurements

Each observation at a specific station is described succinctly in terms of the following mandatory elements:

- Variable (1–01 Observed variable – measurand);
- Geometry (1–04 Spatial extent);
- Programme/network affiliation (2–02).

For each variable at a specific station, there is a subset of the following mandatory and conditional metadata elements:

- From (date) (1–03 Temporal extent);
- Source of observation (5–01);
- Distance from reference surface (5–05 Vertical distance of sensor);
- Exposure of instruments (5–15);
- Configuration of instrument (5–06 Configuration of instrumentation);
- Supervising organization (9–01).

Under this heading, one or more deployments⁴ may be found. The information is structured into two groups of metadata elements: "Instrument characteristics" and "Data generation".

Under "Instrument characteristics" the following mandatory elements are required:

- Observing method (5–02 Measurement/observing method);
- Coordinates (5–12 Geospatial location);
- Uncertainty evaluation procedure (8–02 Procedure used to estimate uncertainty);

⁴ A data series represents the entirety of observations of the same variable taken at a given station. A deployment is a subset of these observations and represents those that were taken without major interruption and under roughly the same conditions.

- Quality assurance logbook (5–08 Instrument control result).

Under “Data generation” the following mandatory elements are required:

- Schedule (6–08 Schedule of observation), which includes month (from–to), day (from–to), and hour (from–to);
- Diurnal base time (6–07);
- Intended for international exchange (Yes/No);
- Schedule of international exchange (7–14), in combination with 6–08;
- Data policy (9–02 Data policy/use constraints);
- Measurement unit (1–02);
- Reporting interval (7–03 Temporal reporting period);
- Reference datum (7–11);
- Data quality flagging system (8–04 Quality flagging system);
- Traceability (8–05).

Other metadata, considered as optional elements of the *WIGOS Metadata Standard* (see *WIGOS Metadata Standard* (WMO-No. 1192)), can be listed under this heading along with complementary information that should be provided if available.

Often, multiple observations are associated with a single station/platform. Observations at a station/platform are listed in English alphabetical order.

Certain metadata elements covering site characteristics may only be relevant to specific types of observation. For example, 4–02 Surface cover classification scheme is generally mainly applicable to observations such as surface-air temperature, humidity, irradiance and precipitation.

3.2.2.1 Instrument coordinates

A method similar to the one referred to in [section 3.2.1.1](#) should be followed for the coordinates of individual instruments (5-12 Geospatial location). If the instruments are located at a single observing point, the station/platform coordinates may be used as an approximation. Where necessary, the actual geospatial location of the instrument (sensing component) is recorded according to the *Guide to Instruments and Methods of Observation* (WMO-No. 8), Volume I, Chapter 1, 1.3.3.2. Additionally, the height or depth of the instrument above or below its reference surface is recorded where appropriate.

3.2.3 Guidance material related to grouping observing facilities to station clusters

3.2.3.1 Definitions

According to the metadata categories and elements outlined in the *WIGOS Metadata Standard* (WMO-No. 1192), three levels of grouping measurements are supported:

- Single instrument/sensor/device: provides independent measurements for one or more variables as part of an observing facility;

- Observing facility⁵ (station or platform): provides measurements/observations from one or more instruments and devices at the same location reporting under the same WIGOS station identifier (WSI);
- Station set or cluster⁶ is an optional element of the WIGOS Metadata Standard "station/platform cluster" (ID 3-10), that allows the grouping of two or more observing facilities, each with its own WSI, for a defined purpose.

The concept of a station cluster as a grouping of observing facilities was introduced to the WIGOS Metadata Standard to address requirements of Members to represent relationships between observing facilities registered under different WSIs. It allows, for example, Members to reflect ownership of infrastructure and/or data, programme affiliation, governance, purpose, historical traceability and connections between observing facilities related to representativeness, exposure conditions, or environmental or geographical characteristics (for example, related to the terrain, mountainous conditions).

OSCAR/Surface is the tool that provides the functionality to establish station clusters. It implements the definition of the WIGOS Metadata Standard as indicated above. In OSCAR/Surface a station cluster is identified by a cluster name and a short description, which allows for details of the rationale for establishing the station cluster to be provided.

3.2.3.2 Members' responsibilities

A station cluster should only be introduced when two or more observing facilities are to be grouped for a clearly defined purpose, to avoid the unnecessary proliferation of such groupings. The decision to group observing facilities into a cluster rests with the Member operating those observing facilities.

If a grouping into a station cluster is required by a single institution or programme, the institution or programme may define such a grouping. Where a cluster is required to group observing facilities with multi-application purposes or operated by different organizations, the Permanent Representative of a WMO Member, via the delegated authority of an OSCAR/Surface national focal point (NFP) in consultation with the WIGOS NFP, may decide on grouping these observing facilities into a station cluster in consultation with the proponent of the grouping and the owner of the observing facility.

3.2.3.3 Procedural guidance

Considering that observing networks and facilities should be designed to meet or address requirements for observations across several purposes and many application areas in the sense of the Rolling Review of Requirements process, multi-purpose observing should be encouraged.

It is up to each Member to decide whether an observing facility belongs to either none, one or several station clusters. To assist Members with the decision on whether to group instruments or observations to form an observing facility with one WSI or a station cluster at surface level, procedural guidance is as follows:

- (a) All instruments providing observations expected to be internationally exchanged as part of the same report/message, under the same WSI, should be grouped under one observing facility (station), not under a cluster.

⁵ The present chapter refers mainly to observing facilities. It should be noted that other comparable terms such as "station" might be used throughout the *Manual on the WMO Integrated Global Observing System* (WMO-No. 1160).

⁶ For consistency the term "station cluster" is used throughout the present Guide.

- (b) The decision to group instruments or observations under one WSI rests with the Member, in compliance with the provisions of the *Manual on the WIGOS*.
- (c) The process for deciding whether a set of observing facilities at surface level with various WSI should be grouped together as a station cluster, or not, is as follows:
 - (i) Create a cluster for the various observing facilities if they have strong commonalities or are strongly related, that is, if at least one of the following conditions is met:
 - All observing facilities observe the same geographic or physiographic feature (for example, a glacier, airport, catchment, research area);
 - Benefits can be identified from grouping them as a cluster and a rationale can be described, for example, grouping them as a cluster might be relevant for data usage or other reasons, although not related to geographic features at all;
 - There is some historical continuity across the observing facilities;
 - The observing facilities are managed together or their data is used together, for example, because they are operated by the same entity or affiliated to the same programme, such as a CryoNet Cluster or a group of buoys.
 - (ii) If none of the conditions above are met, no station cluster should be defined.

Notes:

1. Clustering should not replace nor duplicate the affiliation of observing facilities with programmes/networks (ID 2-02 Programme/network affiliation, as outlined in the *WIGOS Metadata Standard* (WMO-No. 1192)). Cluster and affiliation are different concepts.
2. Creating station clusters is about indicating linkages between observing facilities. The introduction of station clusters will not remove, replace or degrade any existing information in OSCAR/Surface.
3. WSIs are defined at station level (see Figure 3.3 for an example of a station cluster using different WSIs, in Lindenberg) and are essential for international data exchange. WSIs must not be introduced for stations clusters. Therefore, to exchange messages and reports internationally, the WSIs that were assigned to the particular observing facility to which the messages and reports are referring will be used.
4. There is no specific recommendation as to the maximum distance between observing facilities within a station cluster or grouping because the driver for the grouping should be the rationale (see Figure 3.4 for the example of the GAW/GOS Zugspitze-Hohenpeissenberg cluster). Similarly, geographical proximity is not necessarily a rationale for grouping stations.
5. If an observing facility "A" provides data to be used for computing-derived data and/or for reporting observations from another nearby observing facility "B" (for example, precipitation or snow depth observations both being used for the GOS and Global Cryosphere Watch), then both observing facilities "A" and "B" should be grouped together as a station cluster.
6. The *WIGOS Metadata Standard* (WMO-No. 1192) explicitly supports the specification of geospatial location and changes thereof at the level of both the observing facility and individual instrument(s). Therefore, in case an observing facility is replaced by a new one, for example, at a different location, it is recommended that the old (closed) observing facility and the new observing facility (with a new WSI) be linked as a station cluster if the exposure, conditions and representativeness remain the same, even though the location of the instrument changes. This would ensure historical continuity of data series.
7. The concept of grouping observing facilities into station clusters is not limited to land-based stations and can be expanded, for example, to ocean, sea ice or potentially even space weather observing facilities.

3.2.3.4 Station cluster metadata

A station cluster can be configured in OSCAR/Surface by an authorized NFP or metadata editor, by selecting "Station Cluster" under the "Search" tab. The following metadata must be provided when establishing a station cluster:

- Cluster name – this should be unique and representative;
- Cluster description – free text of up to 1 024 characters. The description should provide a rationale for establishing the station cluster, for example, by including additional links to web pages relevant to the purpose of the cluster;
- Names of stations included in the cluster – these are selected from among those already registered in OSCAR/Surface, based on the stated rationale.

Once established, the name and the composition of a cluster is indicated on the OSCAR/Surface page of each station belonging to this cluster, and the list of clustered stations will be available.

Changes to existing station clusters, for example, the addition of stations, are possible only by the authorized NFP or metadata editor.

It is expected that future versions of OSCAR/Surface will be searchable by name and description.

3.2.3.5 Examples from OSCAR/Surface

In OSCAR/Surface the term “station” is used to describe metadata of an observing facility. To avoid confusion, this term is used in the present section.

Example 1: CryoNet clusters

CryoNet clusters are already introduced in OSCAR/Surface following the definition described in the *Manual on the WIGOS* (Chapter 8). See Figure 3.2 for an example of Davos Integrated CryoNet Cluster.

Figure 3.2. Example of a CryoNet station cluster

A CryoNet cluster is defined in the *Manual on the WIGOS* as being comprised of two or more coordinated stations, of which at least one must be a CryoNet station or a CryoNet contributing station together with a station providing representative meteorological observations, and which together, meet the requirements for a CryoNet station.

Example 2: Grouping observing facilities in close vicinity

This example demonstrates possible reasons why a number of observing facilities in close vicinity might be grouped in a station cluster, as is the case in Lindenberg:

- Two or more observing facilities registered under different WSIs host various associated equipment at the same or nearby location but serve different purposes.
- Equipment managed/operated by multiple organizations or for different programmes, registered under different WSIs are installed at the same location. For example, Germany operates a GOS surface station with WSI 0-20000-0-10393, a GCOS Upper-air Network (GUAN) station with WSI 0-20001-0-10393, a Global Observing System (GOS) wind profiler (0-20000-0-10394) as well as a Baseline Surface Radiation Network (BSRN) and Integrated Carbon Observing System (ICOS) station (WSI 0-20008-0-LIN) in close vicinity. These four observing facilities were therefore able to be grouped as a station cluster, named “Lindenberg” (see Figure 3.3).

Figure 3.3. Example of a grouping of observing facilities, in Lindenberg, Germany.

Note: Further stations in this area which do not belong to this station cluster might be shown on the OSCAR/Surface map.

Example 3: Grouping observing facilities to meet a defined purpose

Several observing facilities, identified by their own WSIs and which are not in close vicinity, could also be grouped to a station cluster to meet a defined purpose. These observing facilities may operate different sets of instruments for different programmes and/or be owned by different institutions (9-01 Supervising organization, *WIGOS Metadata Standard* (WMO-No. 1192)). For example, the three Global Atmosphere Watch (GAW) stations Zugspitze-Schneefernerhaus, Zugspitze-Gipfel and Hohenpeissenberg were able to be grouped together, as they are all contributing to the same purpose, and such grouping was also able to include the GOS surface land station Hohenpeissenberg (see Figure 3.4). The decision will always lay on the NFP, or someone with delegated authority in OSCAR/Surface, who should provide such a rationale under the cluster description.

Figure 3.4. Example of a GAW/GOS station cluster, in Zugspitze-Hohenpeissenberg, Germany.

Note: Further stations in this area which do not belong to this station cluster might be shown on the OSCAR/Surface map.

3.2.3.6 Searching for station clusters in OSCAR/Surface

Details on how to add and search for station clusters in OSCAR/Surface and how to find other stations that are part of a cluster can be found in the [OSCAR/Surface User Manual](#).

3.2.4 Station contacts

The details of the station contacts (10-01 Contact (nominated focal point)) are recorded. This may include someone with a relevant function, such as the national or network focal point, the metadata editor, programme approver, instrument expert, or the organization responsible for the data policy. Any user who is not assigned a specific user role/function is considered a regular user of OSCAR/Surface and has minimum access rights to the OSCAR/Surface database. Specific access rights of the different types of users are documented in Table 2 of the *OSCAR/Surface User Manual*.

3.2.5 Bibliographic references

Where the data series or deployment, or methods relating to the data series or deployment, have been previously published or referenced, for example nationally or on the Internet, the references are recorded in this section. OSCAR/Surface allows for the upload of documents. There is no direct correspondence between this section and any particular metadata element of the Standard.

3.2.6 Documents

This section provides access to documents concerning the station/platform or the observed variables. These may include correspondence, instrument calibration certificates, network descriptions and so on. This section may be related with element 4-05 Site information and can be regarded as a historic archive of complementary documentation on the changes in the station/platform, its instruments and conditions of observation.

3.3 SPECIFIC GUIDANCE FOR DIFFERENT TYPES OF STATIONS/PLATFORMS

While the guidance in [section 3.2](#) is intended to be useful for Members managing metadata of any type of station/platform, the following section is intended to provide additional guidance relevant to specific types of stations/platforms.

As mentioned above, the geospatial location of the station/platform should identify the reference location of that station/platform, while the geographic coordinates of the instruments are specified separately for each instrument of the station/platform. A change of coordinates should always reflect a physical relocation of the station/platform and/or instrument. The historical coordinate values of the station/platform location should be retained.

3.3.1 Stations/platforms on land

This section describes the metadata aspects of the main types of observations made on land. It is structured according to the geometry (1-04 Spatial extent), i.e. a point, profile or volume, and to the technology (in situ or remote sensing) used for the observations.

The geospatial location (3-07) of the station/platform may refer to the observation which has existed for the longest period of time, it may be related to the administrative point, or to the primary application area(s) (2-01). The coordinates should be centred over the instrument and the ground elevation should be the natural (undisturbed) surface of the ground.

Stations/platforms on land include observations which are made at a fixed position in relation to the land surface, a mobile observation on land or those which transfer their data to a facility on land. These facilities may be close to land (such as a wharf or on a pylon grounded in the earth). A mobile station may remain in a fixed location during a period of observations or may be mobile during the observation.

3.3.1.1 Surface in situ observations

The observations of the variables at a surface in situ observing station, such as wind speed/direction, air temperature, relative humidity, atmospheric pressure, precipitation, present weather, snow depth, glacier area, permafrost thickness, or sea-ice concentration, made by the instruments/observer located at this station, are described individually. Although such observations are made in situ, they should represent an area surrounding the station, depending on the environmental exposure conditions of the instrument.

Some instruments may measure more than one observed variable at the same time. Each observed variable should be described and the common instrument may be identified through a common serial number. Examples of such instruments include some humidity probes (reporting humidity and temperature), some sonic anemometers (may report wind speed, wind direction, virtual air temperature) and so-called "all-in-one" instruments (for example, reporting temperature, humidity, wind speed, wind direction and pressure).

Surface in situ refers to observations made near the surface of the Earth, over land, for example at automatic weather stations and manual weather stations. The simplest station may make only one observation (for example, rainfall), while others may include observations of several variables, such as air temperature, humidity, wind, soil temperature, rainfall intensity and amount, and snow depth.

The following conditional elements of the WIGOS Metadata Standard are mandatory for fixed stations:

- 3-01 Region of origin of data;
- 3-02 Territory of origin of data;

- 5–05 Vertical distance of the sensor from a (specified) reference level, such as local ground, the deck of a marine platform at the point where the sensor is located, or sea surface;
- 7–11 Reference datum: mandatory for derived observations that depend on a local datum.

3.3.1.2 Upper-air in situ observations

Upper-air in situ observations primarily include observations made using instrumentation attached to meteorological balloons (radiosondes), or unmanned aerial vehicles (also called drones). The balloon tracking for the calculation of winds (that is, by radar or radio-theodolite) is also regarded as an upper-air in situ observation. The radiosonde measurement, often referred to as a sounding, delivers a complete profile from the launch point to balloon burst. To ensure timely availability for the data users the sounding is often split into several messages, but the same metadata are included in all parts of the transmitted messages. Observations such as those made by dropsondes, rockets and kites are also included in this category, but specific guidance for these systems will be included in a later release of the metadata standard.

The majority of the metadata for these systems are also incorporated within the WMO-defined BUFR message and are reported along with the data for each sounding. Because the observations are meaningless without these metadata, the station/platform metadata maintainer and the network metadata manager must ensure that the transmitted metadata are valid and accurate for each reported sounding. To prevent any confusion the metadata reported in BUFR messages must be fully consistent with the WIGOS Metadata Standard elements and with the information inserted into OSCAR.

It is common that the launch point of the balloon has different geospatial coordinates than the station/platform and this can have a significant impact for the data users. It is important that both sets of geospatial coordinates are included in the station/platform metadata database, and that the coordinates incorporated in the BUFR messages are for the balloon launch location. Element 5-12 Geospatial location of the instrument, is related to this, while element 3-07 Geospatial location of the station, refers to the main facility.

Many radiosonde systems no longer include a pressure sensor, and thus the pressure and geopotential height are derived from the Global Navigation Satellite System (GNSS) altitude. The atmospheric pressure can be derived artificially from an estimate of the status of the atmosphere based on WMO-recommended calculus or by using the static predefined International Standard Atmosphere. The metadata defining the source of the pressure and geopotential height measurements are mandatory and must be included in every BUFR message. This relates to element 7–01 Data-processing methods and algorithms, which is an optional element of the Standard.

3.3.1.3 Weather radar observations

Weather radars are active remote-sensing observing systems used to make real-time and high-resolution observations from a large-scale area (up to a radius of 250 km). Weather radar observations have been made particularly for the detection of precipitation, hydrometeor classification and quantitative precipitation estimation. Doppler wind speed and direction can also be reported from some weather radars. Radar station/platform coordinates, height of the location, tower height, frequency, polarization, scanning parameters and other characteristics of weather radar observations are metadata elements contained in the WMO Radar Database (<http://wrd.mgm.gov.tr/Home/Wrd>). Members should continue to collect and supply/update the metadata about their weather radars to the WMO Radar Database (managed by the Turkish State Meteorological Service). The metadata regarding weather radars are transferred from the WMO Radar Database to the OSCAR/Surface by machine-to-machine procedures. Radar metadata cannot be edited manually in OSCAR/Surface.

3.3.1.4 Other surface-based remote-sensing observations

Other surface-based remote-sensing observations include all observations, excluding those from weather radars, made using remote-sensing instrumentation located at a fixed station. These systems are wide ranging in their methods of observation, but primarily result in a measurement profile representative of the atmosphere above the sites or a measurement representative of the cryosphere on the ground. Examples of the atmospheric observing systems in this category are wind profiling radars, lidars, sodars, radiometers, ground-based GNSS receivers, and high-frequency radars. Examples of the cryospheric observing systems are sonic and optical snow measuring instruments, snow pillow, snow scale, and passive gamma radiation instruments. So, both active and passive remote-sensing technologies are considered here.

The majority of the metadata regarding these atmospheric observing systems are incorporated within the WMO-defined BUFR message and thus are only reported along with the data for each sounding. The station/platform metadata maintainer and the network metadata manager must ensure that the transmitted metadata are valid and accurate for each reported sounding.

These atmospheric observing systems often use advanced flagging techniques to identify measurements that do not meet the data quality criteria, and it is mandatory to include this information within the metadata that are transmitted with each message. This relates to elements 8-01 to 8-05 of the Standard (Category 8: Data quality).

3.3.2 Stations/platforms on the sea surface

Sea-surface observations are taken from a variety of stations/platforms. These include moored buoys, drifting buoys, ships and off-shore installations. Also, terrestrial-based (on shore) high-frequency radars (measuring surface current direction and speed) can be considered as such. Variables most commonly measured are air temperature, atmospheric pressure, humidity, wind direction and speed, sea-surface temperature, wave height, wave period, wave direction, sea-level, current speed and direction, salinity, sea-ice thickness, sea-ice concentration, sea-ice type, sea-ice velocity, sea-ice temperature profiles, snow depth on ice, and snow-ice interface temperature.

Ship observations typically include air and seawater temperature, atmospheric pressure, humidity, and wind direction and speed. These are commonly measured automatically. Manual ship observations also include wave height, wave period, wave direction, ceiling (cloud cover), visibility, sea-ice type, sea-ice thickness, sea-ice freeboard, sea-ice concentration, and iceberg position.

Sea-surface observations are also being made from autonomous surface vehicles. These are propelled by wind and/or wave action and measure air temperature, atmospheric pressure, humidity, wind direction, wind speed, sea-surface temperature and sea-surface salinity.

Buoy positions are reported at the time of observation by the organization that operates the platform. Ship positions are also reported at the time of observation; however, many vessels do not report their actual identity due to economic considerations. Autonomous vehicles report their position obtained at the time of observation. The observations are reported under the ownership of the organization that is remotely controlling the vehicle(s).

3.3.3 Airborne stations/platforms

Airborne observations, involving measurements of one or more meteorological variables, are made at particular pre-scheduled intervals in space and time, so at a series of locations (in three-dimensional space). In practice these observations are carried out on board of aircraft called aircraft-based observation stations/platforms. These series of observations deliver profiles near aerodromes or are composed of a series of equidistant observations at constant altitude.

In general, data are reported by three categories of aircraft-based observation stations/platforms using different data relay systems. Examples are:

- (a) WMO Aircraft Meteorological Data Relay (AMDAR): aircraft providing meteorological data according to WMO standards and specifications;
- (b) ICAO Automatic Dependent Surveillance – Contract: aircraft providing data under regulations and cooperative arrangements with ICAO;
- (c) Other aircraft-based observation stations/platforms: data derived from observing systems on aircraft not controlled by WMO or ICAO (called third-party data). Data availability is dependent on arrangements between National Meteorological and Hydrological Services and the data provider as to whether data can be ingested into WIS, taking into account requirements stated in the *Technical Regulations* (WMO-No. 49), Volume I.

The data from aircraft-based observation stations/platforms require that network metadata managers maintain a database of metadata relating to aircraft models and types, and information on sensors and software for processing the data. There will also be a requirement for airport positional metadata with regards to the initiation and termination of profiles.

More details are provided in the *Manual on the WMO Integrated Global Observing System* (WMO-No. 1160), and the *Guide to Aircraft-based Observations* (WMO-No. 1200).

3.3.4 Stations/platforms underwater

Underwater observations can be obtained in a number of ways. These include thermistor strings and devices attached to inductive cabling, expendable bathythermographs, acoustic Doppler current profilers, Argo floats, and conductivity, temperature and depth devices. Bottom-mounted water pressure sensors are used to measure variations in the water column, which are indicative of a low-amplitude wave (tsunami) generated by an underwater disturbance (seismic activity). A new technology, profiling gliders, which are unmanned underwater vehicles, is becoming more widespread. The variables observed by these devices include water temperature, water pressure, salinity, current direction and speed, fluorescence and dissolved oxygen. All of these variables are measured at depth – as deep as the sensors or gliders are located.

The underwater observations obtained from moored buoys use the position of the buoy itself and are reported by the organization that operates the buoy. Expendable bathythermograph positions are taken at the point of launch and are reported by the launch vehicle (ship or aircraft). Acoustic Doppler current profilers and conductivity, temperature and depth devices are usually moored at a specific location, which is reported at the time of observation by the organization operating the device. Argo float positions are reported at the time of observation by the organization operating the device. Unmanned underwater vehicle observations are reported using the position of the vehicle when it begins its subsurface excursion and are reported by the organization piloting the vehicle.

3.3.5 Stations/platforms on ice

Stations/platforms on ice include those established on glaciers and ice caps, ice sheets, ice shelves, pack ice, and moving with ice, as well as those on fast ice. These are often major stations/platforms monitoring the above-mentioned cryosphere components.

Common observed glacier variables are surface accumulation, surface ablation, surface mass balance, glacier area, glacier velocity, calving flux, and glacial runoff, and the first three are also commonly observed ice sheet variables. Basal ablation and ice velocity are commonly observed variables for ice shelves. Stations/platforms for measuring sea ice may either be deployed on fast ice or pack ice and their lifetime depends on the sea-ice survival, with instrumentation on fast ice often recovered before ice breakout and re-deployed during the next ice season. Common observations for sea ice include ice thickness, ice freeboard and

snow depth on ice. Some stations/platforms also measure temperature profiles of sea ice and snow on ice, the temperature at the ice-water interface and at the surface-air interface.

At the time of performing cryospheric measurements, meteorological variables such as air temperature, atmospheric pressure, humidity, wind speed and wind direction may be measured by an Automatic Weather Station (AWS) nearby or by appropriate sensors integrated within the ice instrumentation. Other measurements may include radiation, sensible heat, latent heat, water vapour, and CO₂ fluxes.

Where observing platforms move considerably, their position data are recommended to be integrated in the regular data relay. For near-stationary instrumentation, users are recommended to update the coordinates of stations and observations on a yearly basis, or as frequently as deemed necessary. More detailed moving track can be uploaded as a specific document in the "Documents" section via the [OSCAR/Surface Graphical User Interface](#).

3.3.6 Stations/platforms on lakes/rivers/reservoirs

Records of lake/river gauge height or stage and river discharge are fundamental to the management of water resources, the understanding of streamflow variability in time and space and the calibration of hydrological models used in streamflow and flood forecasting. Gauge heights can be measured in various ways, such as direct observation of a staff gauge or by automatic sensing through the use of floats, transducers, gas-bubbler manometers and acoustic methods. River flows are generally computed through conversion of a record of stage to discharge using an empirically derived rating conversion curve or other hydraulic model. General stream-gauging procedures are recommended in the *Manual on Stream Gauging* (WMO-No. 1044), [Volumes I](#) and [II](#). Hydrological monitoring also includes reservoir inflows, outflows and heights as relevant variables for water resources management.

3.3.7 Satellites

Satellite observations provide information from all areas of the world. These observations deliver information on surface characteristics, as well as atmospheric conditions depending on the instrument type. Essential information about satellites are orbit and type of orbit (geostationary or polar orbiting), height of the satellite, local observation intervals, types of technology applied (active/passive, optical/microwave, imager/sounder) and instrument characteristics (bands measured, footprint, measurement approach such as scanning versus push broom or similar, swath size if applicable, return period, etc.).

Ensuring accuracy and consistency among space-based observations from operational weather and environmental satellites of the Global Observing System (GOS) is essential for climate monitoring, weather forecasting and environmental applications. To this end, the Global Space-based Inter-Calibration System (GSICS), an international collaborative effort initiated in 2005 by WMO and the Coordination Group for Meteorological Satellites (CGMS), develops common methodologies and implements operational procedures to ensure quality and comparability of satellite measurements taken at different times and locations, using different instruments operated by various satellite agencies. This is achieved through a comprehensive calibration strategy which involves: (a) monitoring instruments' performance; (b) operational inter-calibration of satellite instruments; (c) tying the measurements to absolute references and standards; and (d) recalibration of archived data. The resulting intercomparisons achieve inter-calibration when the measurements are traceable to absolute references and standards. The Global Space-based Inter-Calibration System contributes to the integration of satellite data within WIGOS.

Meteorological satellites usually transport a variety of instruments, each mounted for specific applications required by a diverse user community. In fact, due to the variety of instruments and the specific observation programme chosen, the related metadata are different from those obtained with the classic surface-based observations (see the *Guide to Instruments and Methods of Observation* (WMO-No. 8)). As a consequence, metadata for satellite observations with calibration information are collected in a separate database, OSCAR/Space.

5. OBSERVING NETWORK DESIGN

5.1 INTRODUCTION

The observing network design principles are provided in the *Manual on the WIGOS*, Appendix 2.1. The 12 principles are short and therefore abstract. National Meteorological and Hydrological Services (NMHSs) designing and evolving their observing system networks need more concrete guidance on how to respond to these principles. This chapter thus provides for each principle a set of more specific guidelines or recommendations on their interpretation and implementation.

Some recommendations apply across several principles. For ease of interpretation, these points are repeated wherever applicable.

In some cases in this chapter, rather abstract terms are used. These terms sometimes have their origin in a specific area of meteorological observation, such as in ground-based observation. The terms “network design” and “observing networks”, for example, are regularly used and accepted when describing the process of creating a network of ground-based observing sites in a country, and thus when considering aspects like appropriate distance between stations, other siting conditions or the frequency of observations. The term “network design” can and is already being used in the area of space-based observations. However, this additional application has not yet been adopted generally. Therefore, it is important to recognize that many guidelines and recommendations in this chapter – when referring to, for example “network design” or “observing networks” – are not necessarily restricted to ground-based observations but should be applied to all observing systems.

Abstract or conceptual terms and definitions, for example “integrated station network”, are also sometimes used for the purpose of making certain guidelines and recommendations more generally applicable. Explanations of such abstract terms can be found in the [annex to the present chapter](#).

5.2 GUIDANCE ON THE OBSERVING NETWORK DESIGN PRINCIPLES

Note: For convenience, the observing network design principle is reproduced in parentheses and italic under the name of each principle.

Principle 1. Serving many application areas

(Observing networks should be designed to meet the requirements of multiple application areas within WMO and WMO co-sponsored programmes.)

Note: A WMO application area is an activity involving the direct use of observations that allows National Meteorological and Hydrological Services or other organizations to render services related to weather, climate, water and other environmental events,⁷ contributing to public safety, socioeconomic well-being and development in their respective countries. The concept of a WMO application area is used in the framework of the WMO Rolling Review of

⁷ In the context of the WMO Strategic Plan 2020–2023 (WMO-No. 1225), the term “weather” refers to short-term variations in the state of the atmosphere and their phenomena or effects, including wind, cloud, rain, snow, fog, cold spells, heatwaves, drought, sand and dust storms and atmospheric composition, as well as tropical and extratropical cyclones, storms, gales, the state of the sea (for example, wind-generated waves), sea ice, coastal storm surges, and so forth. “Climate” refers to longer-term aspects of the atmosphere-ocean-land surface systems. “Water” includes freshwater above and below the land surfaces of the Earth, and its occurrence, circulation and distribution, both in time and space. Related “environmental” issues refer to surrounding conditions affecting human beings and living resources, for example, the quality of air, soil and water, as well as “space weather” – the physical and phenomenological state of the natural space environment, including the Sun and the interplanetary and planetary environments.

Requirements⁸ and describes a homogeneous activity for which it is possible to compile a consistent set of observational user requirements agreed by community experts working in this area.

- (a) When designing observing networks, the needs of WMO application areas, as regulated in the Manual on the WIGOS, should be taken into account. In particular, see the [WMO Rolling Review of Requirements](#) process, the WIGOS database of user requirements for observations ([OSCAR/Requirements](#)) and the [Statements of Guidance](#) which together represent all application areas, and the *High-Level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040* (WMO-No. 1334). As an example, the design of observing networks implemented primarily in support of operational weather forecasting should also take into account the requirements of other applications areas, such as climate monitoring.
- (b) Where practicable, observing networks should be designed and operated in such a way that the needs of multiple applications are addressed. It is acknowledged that different applications have different, and sometimes conflicting, requirements; when an observing network is implemented primarily to serve the needs of one application, compromises may be needed in its ability to serve others. Nevertheless, the requirements of other applications should be actively considered during network design.
- (c) As part of the management of an observing network, a user consultation procedure should be implemented through which the requirements of different application areas can be ascertained, considered and analysed simultaneously. (See also [principle 2.](#))
- (d) In order to respond to the needs of its programmes, WMO engages in partnerships with other bodies responsible for observations through co-sponsored programmes (see relevant comments in the preamble to the *High-Level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040* (WMO-No. 1334). These partnerships should be taken into account when designing observing networks.
- (e) Partnerships with other organizations (such as those involved in road transportation or electric power generation), including partner organizations responsible for observations, should be exploited through the integrated and multi-purpose design of observing networks in order to achieve synergies between networks and/or domains and improve cost-effectiveness.

Principle 2. Responding to user requirements

(Observing networks should be designed to address stated user requirements, in terms of the geophysical variables to be observed in the applicable domains (vertical layer/s and horizontal coverage), the space-time resolution, uncertainty, timeliness and stability needed, and taking into account relative priorities.)

Note: User requirements for observations are documented and quantified in the Observing Systems Capability Analysis and Review tool (OSCAR/Requirements). The user requirements as stated in OSCAR are high-level in the sense that they are not intended to capture all the detailed requirements that must be considered when designing a specific observing system. The requirements in OSCAR/Requirements should therefore be taken into account, but they are not sufficient to provide a full description of the observing system requirements.

- (a) User communities should be involved in the observing network design. To ensure that observing networks respond to the key needs of the user communities, specific decisions about observing network design should include a consultation stage with appropriate application area representatives. A procedure should be implemented to allow a documented collection and synthesis of detailed user requirements.

⁸ The WMO Rolling Review of Requirements is described in the Manual on the WMO Integrated Global Observing System (WMO-No. 1160), Appendix 2.3.

- (b) When designing their observing networks, Members should take into account the actions listed in the High-Level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040 (*WMO-No. 1334*), as well as the gap analyses from the [Statements of Guidance](#) for all application areas.
- (c) Members should conduct further studies to assess the feasibility of addressing with existing technology the observational user requirements specified in OSCAR, including differences in requirements, as well as the additional detailed requirements that may not be specified in OSCAR and national requirements, taking resources and cost-effectiveness into account. (See also [principle 5](#).)
- (d) Observational data should be processed to a level to be established in consultation with users (for example, raw instrument data, calibrated instrument data or retrieved geophysical variable). This should include an agreement on quality control, formats, etc. The appropriate level of processing will vary according to the user communities' needs and to the intended applications. Appropriate resources should be allocated to these data-processing requirements. Also, where supported by user requirements, appropriate resources should be allocated to archiving the raw data and metadata, such that data can be reprocessed at a later date.

Principle 3. Meeting national, regional and global requirements

(Observing networks designed to meet national needs should also take into account the needs of WMO at the regional and global levels.)

- (a) National observing networks are designed and established by Members primarily to respond to their own national needs/requirements, in many cases in agreement with other Members and in accordance with WMO regulatory and guidance material. However, when implementing these national networks, Members should also take into account the requirements for global and regional applications. For example, Members should consider small additional commitments or adjustments (for instance, in terms of data storage, data policy, availability, exchange and documentation) to make data useful to other Members.
- (b) WIGOS regulations should be adopted for observing networks that are implemented primarily to respond to national needs.
- (c) Procedures through which national user requirements are collected and assessed (see [principle 2, paragraph \(a\)](#)) should be designed in such a way that regional and global requirements can be addressed simultaneously.
- (d) For each national network/site, a network/site definition document should be maintained containing information on:
 - (i) Planned observing capabilities of the network/site;
 - (ii) Target performances;
 - (iii) User requirements to which the network/site responds.

Principle 4. Designing appropriately spaced networks

(Where high-level user requirements imply a need for spatial and temporal uniformity of observations, network design should also take account of other user requirements, such as the representativeness and usefulness of the observations.)

- (a) In general, the composite observing network should be designed in such a way that it delivers basic observations that are quasi-uniform in space for observed variables and resulting from an analysis of the 3D-resolution requirements provided in [OSCAR](#). Gaps

should be assessed in accordance with the *Manual on the WIGOS*. (See also [principle 5](#) for guidance on composite network design.)

- (b) However, for some application areas, the representativeness of observations may be a more important design driver than spatial and temporal homogeneity. In such cases, the density of an observing network should be adjusted according to the variability of the observed phenomena in a given region, for example to address the need for greater density of some observations in mountainous and coastal areas where steep gradients in geophysical variables exist. Also, observing networks should be designed with spatial and temporal spacing such that severe, extreme and high-impact events, often of short duration, are captured, and such that climate-relevant changes (for example, diurnal, seasonal and long-term interannual) can be resolved.
- (c) When considering priorities for additional observations, attention should be given to: data-sparse regions and domains, poorly observed variables, regions sensitive to change and regions which experience environmental phenomena that place populations at risk. As these are not always located within the territory of the country needing the observations, this creates a need to acquire observations in areas outside the territory of the funding nation or group of nations (for example, the Network of European Meteorological Services funding of the EUMETNET Automated Shipboard Aerological Programme, or the Global Climate Observing System (GCOS) Cooperation Mechanism).
- (d) Observing networks should be designed taking into account measurements and gaps of other systems in the vicinity, such as measurements using the same technology in neighbouring countries or measurements from networks using different technologies, both surface-based and space-based.
- (e) Surface-based observations have to be representative for specific applications. Sites representative⁹ of local features should be generally avoided (for example, on steep slopes, in hollows, in proximity to pronounced features such as buildings, topographical influences or ridges) unless sited for a specific purpose and application.
- (f) Non-NMHS observations can provide valuable measurements for filling in observational gaps. In many areas these may be the only available observations, particularly for elements requiring higher density measurements such as precipitation, and extreme events such as hail or windstorms. NMHSs should investigate collaborations with others within their country in order to complement existing networks, share resources and address gaps. For observations of this type, special attention should be given to possible data policy issues, and the guidance given under [principle 3, paragraph \(a\)](#), should be followed.
- (g) Where possible, objective tools should be used to assess the impact and benefit of observations, including to demonstrate the impact of observation density. Such tools (for example, Observing System Experiments, Observing System Simulation Experiments or forecast sensitivities to observations) exist in Numerical Weather Prediction and are well-proven. The development of equivalent tools for other application areas is encouraged.

Principle 5. Designing cost-effective networks

(Observing networks should be designed to make the most cost-effective use of available resources. This will include the use of composite observing networks.)

- (a) Observing networks should be designed using the most appropriate and cost-effective technologies or combinations of technologies. Guidance documents on existing technology

⁹ See the *Guide to Instruments and Methods of Observation* (WMO-No. 8), Volume I, Annex 1.D. Siting classifications for surface observing stations on land.

should be consulted. For example, reference can be made to the [*Guide to Instruments and Methods of Observation \(WMO-No. 8\)*](#), the [*Guide to Climatological Practices \(WMO-No. 100\)*](#), Chapter 2, 2.5; the *Guide to Agricultural Meteorological Practices (WMO-No. 134)*, Chapter 2, 2.2.4 and 2.4.1.11.3; and the *Guide to the Global Observing System (WMO-No. 488)*, Part III, 3.1.

- (b) Developments to observing networks should, where possible, build on and lead to the consolidation of existing subnetworks, capitalizing on both existing and new technology and integrating new networks into existing WIGOS capabilities.
- (c) The observing network should evolve in response to changing user requirements. Designs should be sufficiently flexible to allow for incremental expansion, or contraction, without the need for complete network redesign.
- (d) Partnerships with other organizations responsible for observations should be established or maintained in order to build on potential synergies, share costs and provide more cost-effective multi-purpose networks. Other organizations may include WMO partners (see the relevant comments in the *High-Level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040 (WMO-No. 1334)*) or national governmental and non-governmental organizations.
- (e) Observing network design should, where possible, be based on the results from scientific studies which assess the impact, importance and value of the observations for the applications to which they contribute. Complementary impact-per-cost studies should also be conducted in order to address the cost-effectiveness of various possible observing systems when designing networks.
- (f) Space-based and surface-based observing networks should be designed and operated in such a way that they are complementary, with appropriate activities and cooperation between the communities responsible for these networks, to ensure that observations from each network are used to enhance the impact and effectiveness of the other.
- (g) Observing networks should be designed taking into account measurements available from other networks in the vicinity, including in neighbouring countries, or measurements from networks using different technologies.
- (h) To optimize benefits within a Member's own territory, an effective observing network may require investment outside the Member's territory. This may be realized through, for example, regional collaboration.
- (i) Network design may include the need for visual/manual observations and observations of phenomena not necessarily well detected/identified by automated systems or that are more cost-effective detected manually.

For space-based observing systems

- (j) Space-based observing systems that continue to meet calibration and stability requirements may remain cost-effective for longer than their expected lifetime. Operators should consider continuing to operate such systems at a lower level of maintenance after the designed lifetime.

Principle 6. Achieving homogeneity in observational data

(Observing networks should be designed so that the level of homogeneity of the delivered observational data meets the needs of the intended applications.)

- (a) Only observing technologies with adequately characterized performance should be deployed to ensure that levels of observational quality consistent with user requirements are attained.

- (b) Observing networks should be operated to meet agreed performance targets.
- (c) Observing networks and stations should be assessed regularly using objective criteria to ensure that the desired performance standards are being met.
- (d) As part of routine operations, the quality and homogeneity of data should be regularly assessed through an ongoing programme to monitor performance of the network. This may include both automated and manual checks.
- (e) A comprehensive monitoring of data availability, timeliness and quality should be implemented. For appropriate observation types, this should include monitoring of short-range Numerical Weather Prediction. Monitoring should also be implemented to help detect various types of errors, for example, non-timely or missing data, improperly coded observations and grossly erroneous measurements.
- (f) Monitoring results may be made available in different ways, for example, via web portals, regular reports (review of overall performance statistics) or fault reports (focus on detected errors at specific sites).
- (g) When station relocations or instrument upgrades are made, a sufficient period of overlap between the old and new systems, considering the targeted application areas, should be made whenever practicable. (See also [principle 12.](#))
- (h) The availability of complete metadata is essential to assess the homogeneity of observations. (See also [principle 10.](#))
- (i) For many applications including climate monitoring, it is important that calibration, calibration monitoring and intercalibration be designed as part of the observing network. For applications in (near) real-time, it is important that calibration information be made available in (near) real-time. It is also important that raw data be archived so that they can be reprocessed at a later date to improve their homogeneity.
- (j) Intercomparisons and validation of observations made using different technologies should be undertaken in order to improve understanding of observational uncertainty or relative performances (bias, standard deviation, gross errors).
- (k) While some non-NMHS observations may be collected using non-standard formats, where possible all observations should be disseminated using standard quality rules, standard formats and according to standard dissemination procedures.
- (l) Observations should be disseminated in such a way that the quality and provenance of the original measurement are retained.
- (m) Members should give a high priority to maintaining the operations of observing stations/sites/systems that have long-term data series, especially for climate applications.
- (n) For climate monitoring applications, surface-based stations should be sited in locations that are least likely to be impacted by changes through time in the natural or man-made environment.

Principle 7. Designing through a tiered approach

(Observing network design should use a tiered structure, through which information from reference observations of high quality can be transferred to other observations and used to improve their quality and utility.)

Note: In addition to improving the quality and utility of observations, this approach will also lead to improvements in the understanding of the quality of the observations.

- (a) The tiered approach¹⁰ should include, as a minimum, a sparse network of reference stations (for example, the GCOS Reference Upper-air Network) from which other stations can be benchmarked. Reference stations should be calibrated to the International System of Units or community-accepted traceable standards with fully quantified uncertainties, have the highest level of robustness (for example, duplicate or triplicate sensors of key variables such as temperature and precipitation), be well sited in locations least affected by urbanization and other non-climatic influences, have regular maintenance and replacement cycling of instruments, have the highest standard of metadata collection including photo documentation, and have continuous monitoring of system performance to resolve instrument and environmental issues as they arise.
- (b) Stations such as the baseline networks of the Global Climate Observing System (the GCOS Surface Network and GCOS Upper-air Network) can form an intermediate data layer, with quality between that of reference stations and the larger comprehensive network of observing stations.¹¹
- (c) In the field of space-based observing, satellite redundancy should be used whenever appropriate to ensure the reliability of data provision from certain orbits. With regards to ground-based observations, even at non-reference stations, instrument redundancy should be used whenever appropriate to ensure the reliability of the observation and measurement accuracy.
- (d) In addition to geostationary and low-Earth orbit Sun-synchronous constellations, space-based observing networks should include high-eccentricity orbits to permanently cover the polar regions, low- or high-inclination low-Earth orbiting satellites for comprehensive sampling of the global atmosphere, and lower-flying platforms, such as short-life nanosatellites, as gap fillers.
- (e) A network of other NMHS or non-NMHS stations can be interspersed with a subset of high-quality stations for more complete coverage.
- (f) Network design should include consideration of skills and training needed for staff, which is expected to be different at different levels in the tiered structure. Expertise of staff at reference stations should be used to provide guidance to other parts of the network.

Principle 8. Designing reliable and stable networks

(Observing networks should be designed to be reliable and stable.)

- (a) The design and implementation of observing networks should ensure that standard operating procedures and practices are followed, including appropriate maintenance and calibration procedures.
- (b) Data quality objectives should be defined for each network. Decisions will need to be made regarding the level of quality control to be applied. Fully automatic quality control with no manual assessment may be the most cost-effective but in some cases may result in a lower level of quality.
- (c) The criteria for selecting the station site/satellite orbit should be based on the purpose and tier of the network. Criteria associated with the length of time the station/satellite will

¹⁰ For a tiered approach, see GCOS Reference Upper-air Network (GRUAN): Justification, requirements, siting and instrumentation options, GCOS-112 (WMO/TD No. 1379).

¹¹ See the *GAIA-CLIM Report/Deliverable D1.3. Gap Analysis for Integrated Atmospheric ECV Climate Monitoring: Report on System of Systems Approach Adopted and Rationale* (<http://www.gaia-clim.eu/workpackagedocument/d13-report-system-systems-approach-adopted-and-rationale>).

be operated, available energy sources, data transmission options, and factors associated with homogeneity and the local environment should be considered.

- (d) Training should be commensurate with the network tier. A basic network consisting of manual observations should focus on sound observing techniques and methods for data recording and dissemination. For automated networks, training should focus to a greater degree on maintenance and operation of instruments and automatic data collection methods. The operation of reference networks will require the greatest level of training and higher standards for calibration, inspection, maintenance and management.
- (e) Observing networks, both ground-based stations and space-based systems, and their telecommunications should be designed to be robust against exposure to severe weather and hydrological, climate and other environmental conditions (such as geomagnetic storms or space debris in case of satellites).
- (f) A combination of standard and backup power sources (sustainable sources such as solar, water and wind for ground-based stations and other appropriate sources for satellites) should be used whenever possible to better ensure uninterrupted operation of observing platforms in all environmental conditions.
- (g) When possible, data should be made available to global collection centres where data monitoring can be performed and feedback provided in near-real-time regarding data quality, including the frequency and character of observational errors, reporting percentages, completeness and timeliness.
- (h) Monitoring procedures described under [principle 6](#) should also help in assessing the current and long-term reliability and stability of networks.
- (i) The functioning of the operations of an observing network and its components should be monitored and supported by incident/fault management in order to improve the reliability and stability of a network.
- (j) For climate monitoring, special attention should be given to maintaining stations/satellite orbits with long, historically uninterrupted records and to maintaining their homogeneity in location, instrumentation and observing procedures.
- (k) Parallel long-term data storage (for example, on site) should be designed to augment real-time dissemination, which will help ensure that original observations are preserved (for example, on site) to allow for the higher level of quality and completeness required for climate applications.
- (l) Station sites/satellite orbits should be selected in areas least likely to be impacted by factors such as new construction that will force station relocations.

Principle 9. Making observational data available

(Observing networks should be designed and should evolve in such a way as to ensure that the observations are made available to other WMO Members, at space-time resolutions and with a timeliness that meet the needs of regional and global applications.)

- (a) Data availability gaps with respect to the stated user requirements must be addressed. Members should: (i) make efforts to collect and disseminate observations that are made but not currently collected centrally; (ii) exchange existing data internationally in accordance with the *Manual on the WIGOS*; and (iii) improve data timeliness.
- (b) Mechanisms should be established to minimize the loss of existing observational data and to promote the recovery of historical records for climate applications.

- (c) Multiple and overlapping methods of dissemination (for example, through multiple routes) that comply with the *Manual on the Global Telecommunication System* (WMO-No. 386) should be used to improve continuity of data delivery to users.
- (d) Cloud concepts and other methods for expanding telecommunication capacities should be considered for managing the rapid growth in data volumes of 2D- and 3D-scanning remote-sensing observing systems (such as satellites and radars).
- (e) To facilitate data availability and access, WMO-defined standard data formats should be used for data exchange.

For climate applications

- (f) All raw data and agreed subsets of processed data should be collected into a documented and permanent data and metadata record following common standards (see, for example, the [*Guideline for the Generation of Datasets and Products Meeting GCOS Requirements, GCOS Report No. 143*](#) (WMO/TD-No. 1530)) and archived in a World Data Centre or other recognized data centre.
- (g) A sustained operational capability is required to produce and maintain the archived data record throughout and after the life of the observing network.
- (h) Resources should be allocated to ensure appropriate reprocessing of observational data to respond to the needs of climate applications.

Principle 10. Providing information so that the observations can be interpreted

(Observing networks should be designed and operated in such a way that the details and history of instruments, their environments and operating conditions, their data processing procedures and other factors pertinent to the understanding and interpretation of the observational data (i.e. metadata) are documented and treated with the same care as the data themselves.)

- (a) Metadata practices should adhere to the WIGOS Metadata Standard as specified in the *Manual on the WIGOS* and the *WIGOS Metadata Standard* (WMO-No. 1192).
- (b) Members should follow standard procedures to collect, check, share and distribute the WIGOS metadata that are required for international exchange, to ensure appropriate homogeneous use of the observational data and knowledge of their quality and traceability; additional WIGOS metadata should be recorded by Members and made available on request.
- (c) Station metadata should be created at the time of network installation and updated regularly to include information such as station location, the surrounding environment, instrumentation type and calibration metrics, observing practices and maintenance. Whenever possible, photographic images of the station and environment should be made and archived annually.
- (d) WIGOS metadata should be updated whenever changes occur, including changes in sheltering and exposure, mean calculations, observation hours, land use, instrument types, quality control, homogenization and data recovery procedures.
- (e) Wherever possible, users should be given advance notice of changes in instruments and data processing.

Principle 11. Achieving sustainable networks

(Improvements in sustained availability of observations should be promoted through the design and funding of networks that are sustainable in the long-term including, where appropriate, through the transition of research systems to operational status.)

Note: In this context, “sustainable” means that the network can be maintained in the medium to long term. This is desirable for most operational applications and is required for climate monitoring. Requirements for systems to be robust and for their data to be of appropriate quality are discussed under other principles.

- (a) Where appropriate, some research-based systems, namely those that are mature and cost-effective, should evolve to a status of secure, long-term funding, while maintaining or improving the availability and quality of the observations.
- (b) The transition of research observing systems or new observing technologies to long-term operations requires careful coordination between data providers and users (both research and operational users).
- (c) Members should ensure that their funding for the sustained networks remains sufficient in the longer term taking into account the required evolutions and changes (for example, in technology). (See also [principle 12](#).)
- (d) The transition of research-based observing systems or new observing technologies to long-term operations should include the design of robust and maintainable systems that assure appropriate data collection, quality control, archive and access.
- (e) Members should take steps to make preoperational data available to users on a best efforts basis to facilitate early uptake and adoption of the new data, once operational.
- (f) A written agreement for the operational collection and archive of observations should be made with a recognized archive centre.
- (g) When selecting sites/stations/satellite orbits, network planners and administrators should consider locations that can be secured through long-term agreements (for example, leases or ownership for ground-based observing sites).
- (h) Other useful guidance material is available in the GAIA-CLIM Report/Deliverable D1.3. Gap Analysis for Integrated Atmospheric ECV Climate Monitoring: Report on System of Systems Approach Adopted and Rationale (see footnote 4 for reference information).

Principle 12. Managing change

(The design of new observing networks and changes to existing networks should ensure adequate consistency, quality and continuity of observations during the transition from the old system to the new.)

Note: When considering which changes might be consistent with WMO strategy, reference should be made to the *High-Level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040*.

- (a) The impact of new systems or changes to existing systems on user applications should be assessed prior to implementation, taking into account the observational user requirements of all application areas.

- (b) A suitable period of overlap between old and new observing systems¹² is required (meaning parallel observations) to maintain the homogeneity and consistency of observations in time.
- (c) Test beds and pilot projects are required through which new systems can be tested and evaluated and guidelines for operational transition (including the production and dissemination of the necessary new metadata) developed.
- (d) The objective tools assessing the impact and benefit of observations for certain application areas should be used, where possible, to support change management. (See also [principle 4](#).)

For climate applications

- (e) To avoid gaps in the long-term record, continuity of key measurements should be ensured through appropriate strategies.
- (f) When a period of overlap between old and new systems is not possible, other methods, such as paired observations (co-location of original and new instrumentation), should be used.
- (g) When introducing a change, efforts should be made to retain as many similarities as possible between the old and new system (for example, similar site exposure for ground-based systems, similar orbital position for space-based systems, similar procedures, instruments and sensors).

Principle 13. Advancing environmental sustainability

(The environmental impacts of observing networks should be considered in their design and operation. Advancements in the environmental sustainability of networks should be promoted where viable solutions are available that meet user requirements.)

Notes:

(1) In this context "Environmental Sustainability" means the practice of conserving, maintaining and protecting global ecosystems while planning observing systems across all domains without adding unnecessary strain on ecosystems. Principle 13 "Advancing environmental sustainability", Principle 8 "Designing reliable and stable networks" and Principle 11 "Achieving sustainable networks", must be balanced in the context of the value of the observation as determined by appropriate impact planning/assessments.

(2) In the context of this Principle, observing system means the observing system in itself and also the infrastructure and works required for deployment, operation and decommissioning, for example the construction of specific roads, buildings, power generators, data and power lines, and ground work.

- (a) Environmental impacts should be considered for the entire lifecycle of an observing system from design, procurement, manufacturing and transport to operations, maintenance, calibration, decommissioning and disposal.
- (b) When planning an observing network, efforts should be made to ensure optimized operations that will reduce duplication and their associated negative environmental impacts (for example, land space required, maintenance and site visits, and power consumption).

¹² See the Manual on the WMO Integrated Global Observing System (WMO-No. 1160), 2.4.6.3; the Guide to Instruments and Methods of Observation (WMO-No. 8), Volume III, 1.1.3; the Guide to Climatological Practices (WMO-No. 100), 2.6.7; and the Guide to the Global Observing System (WMO-No. 488), 3.2.1.4.4.4 and 3.7.4.

- (c) Opportunities to implement a tiered network approach should be considered at the network design stage to minimize negative environmental impacts while ensuring the fit-for-purpose data quality of an observing system.
- (d) Implementation of innovative methods of observation and technologies for increasing environmental sustainability should be explored. Solutions could include selection of equipment and infrastructure that is robust and re-useable, use of environmentally friendly materials and of renewable energy sources.
- (e) At every opportunity along the lifecycle of an observing system, consideration should be given to minimizing the negative environmental impacts of physical and hazardous waste. This includes reducing waste in general, as well as ensuring proper disposal.
- (f) Procurement activities should include clauses in tender documents specifying the requirements for environmental sustainability.

ANNEX. EXPLANATION OF TERMS RELATED TO OBSERVING NETWORK GUIDANCE

Note: Formal definitions of terms are published in the *Technical Regulations* (WMO-No. 49), [Volumes I, II and III](#), and their annexes, the Manuals, rather than in Guides.

An integrated station network consists of multi-purpose stations and/or stations of different types in the same geographical area in which agreed WMO practices are applied.

A tiered network is a network designed in accordance with (or following) an industry standard hierarchical network model. Tiers are used to organize subnetworks into groups within a domain network. A domain network is composed of one or more tiers forming either a hierarchy of tiers or partitioned groups of tiers. A single tier defines a collection of individual subnetworks that all have the same subnetwork definition.

Third parties are persons or organizations who are not a party to a contract or a transaction but are involved. The third party normally has no legal rights in the matter, unless the contract was made for the third party's benefit.

6. GUIDANCE ON NATIONAL WIGOS IMPLEMENTATION

6.1 INTRODUCTION

The purpose of this chapter is to assist WMO Members in developing their National Observation Strategy and National WIGOS Implementation Plan, to enable them to implement the WMO Unified Policy for the International Exchange of Earth System Data and to design, plan and develop their national observing system (NOS) as a national WIGOS observing component and as a national contribution to the Global Basic Observing Network (GBON).

This chapter is aligned with WIGOS-related technical regulations and guidance material developed under the governance of the Commission for Observation, Infrastructure and Information Systems and the former Inter-commission Coordination Group on WIGOS (ICG-WIGOS).

6.2 NATIONAL WIGOS IMPLEMENTATION

For WIGOS to deliver on its vision for "an integrated, coordinated and comprehensive observing system to satisfy, in a cost-effective and sustained manner, the evolving observational requirements of Members in delivering their weather, climate, water and related

environmental services", commitments and actions are required at the global, regional and national levels.

During the WIGOS Initial Operational Phase (2020–2023),¹³ national-level WIGOS implementation, including necessary capacity development, partnership agreements and integration of observing systems for all application areas, was one of the highest priorities for WIGOS.

In this period, an important underlying issue was the need to implement sound practices, policies and capabilities within individual meteorological, climatological, hydrological and other relevant environmental institutions and partner organizations in relation to the life cycle management of data. This is important for ensuring that Members are able to manage their observations and data efficiently and effectively, to maximize the value and impact of the data in support of their services, and to integrate observations and data from diverse platforms and from external sources (such as the academic community, the private sector and third parties) to support the implementation of the WMO Unified Policy for the International Exchange of Earth System Data and the establishment of the Global Basic Observing Network¹⁴.

During the WIGOS Initial Operational Phase, National Meteorological and Hydrological Services (NMHSs), working with their national partners, were expected to take on greater responsibility for the national implementation of WIGOS and to use the framework provided by WIGOS to exert leadership in the acquisition and management of meteorological, climatological, hydrological, oceanographic and other relevant environmental observations at the national level.

NMHSs should strive to act as the key players at the national level, both by strengthening their own observing systems in accordance with the *Technical Regulations* (WMO-No. 49), Volume I, and by building national partnerships and providing national leadership based on their experience in the acquisition, processing and dissemination of observational data for environmental monitoring and prediction purposes. Data customers are demanding more data and information be delivered precisely when and how they need it. As a key national service provider, NMHSs have to respond effectively to this rapidly evolving data landscape.

The leadership of NMHSs in integrated observing systems and the engagement of national partners are central to the success of WIGOS implementation. WIGOS provides NMHSs with an opportunity to strengthen their role in all aspects of their national mandates, including national coordination and exchange of observations across all relevant domains (weather, climate, hydrology, space weather, ocean, atmospheric composition, cryosphere, environment, etc.) and to reinforce their status as the national meteorological and hydrological service provider of choice.

Proactive engagement with all relevant stakeholders, users and partners, is a great opportunity to build stronger relationships. Both formal and informal, regular and ad hoc, productive two-way communication with stakeholders is needed.

NMHSs are operating in a rapidly changing environment in terms of technological advances and the growing demand for more and more diverse services from increasingly sophisticated and capable users. Technological advancements and related trends such as big data and crowd sourcing, the emergence of commercial observing networks, data and service providers, and the affordability of digital technology, all are game changers that require rapid adaptation and change in behaviour in both the NMHSs and the private sector.

¹³ See Executive Council: Abridged Final Report of the Seventy-third Session (WMO-No. 1277), Resolution 9.

¹⁴ World Meteorological Congress: Abridged Final Report of the Extraordinary Session (WMO-No. 1281), Resolution 1 and Resolution 2, respectively.

The private sector may contribute by accelerating the uptake of technological innovations, and might be able to assist NMHSs in providing more efficient, attractive and accessible personalized services. National Meteorological and Hydrological Services will benefit from working with private sector partners to introduce those innovative methods into their own operations. There are many opportunities for optimization and efficiency through integration of networks, computing power and service delivery.

Expected outcomes, at a minimum, can be as follows:

- (a) Enhanced national integrated observing system delivering better and better documented observational input to support the needs of national services in a more cost-effective way;
- (b) Enhanced capabilities to identify and address gaps in global, regional, subregional and national observing systems in the context of user needs, issues, etc.;
- (c) Increased integration and free and unrestricted sharing of observations from various sources (NMHSs and other governmental and non-governmental organizations, research institutes, volunteer networks, the private sector, etc.) across national and regional boundaries to support improved service delivery by Members;
- (d) Progressively greater availability and quality of WIGOS observational data and metadata;
- (e) Increased visibility and strengthened role of NMHSs, as a partner, enabler and integrator of observations, at the national level;
- (f) Enhanced cooperation and collaboration with partners at the national and regional levels;
- (g) Enhanced culture of compliance with the Technical Regulations (WMO-No. 49), Volume I, Part I, and the *Manual on the WIGOS*;
- (h) Improved human and technical capacity of Members for planning, implementation and operation of WIGOS.

NMHSs, as enablers and integrators of observations at their national level, will reach out to their national partners, such as other governmental and non-governmental organizations, research institutes, volunteer networks and the private sector, to develop and maintain agreements using suitable mechanisms (such as Memorandums of Understanding or contracts) which articulate the benefits of the partnership and specify the roles and responsibilities of the participants. Chapter 7 provides details.

To achieve the above, the following key activities are envisaged at the national level:

- (a) Analysis of current and future national strategic requirements, needs and priorities, and biggest gaps in observations, systems, processes, capabilities, legal and institutional frameworks, etc.;
- (b) Analysis of the national implications of the WMO Unified Policy for the International Exchange of Earth System Data with respect to core data, the WIGOS-relevant provisions of the *Technical Regulations* (WMO-No. 49), Volume I, Part I, and the *Manual on the WIGOS*, with a strong emphasis on the Global Basic Observing Network regulations, and a culture of compliance;
- (c) Promotion of alignment of national policies and regulations concerning Earth system data sharing and exchange, nationally and internationally, with the WMO Unified Policy for the International Exchange of Earth System Data;
- (d) If not already in place, establishment of national governance and key-partnerships to enhance the exchange of Earth system data among national and regional stakeholders in order to improve integration of data across disciplines and domains;

- (e) Strengthening effective coordination and collaboration with relevant partners and stakeholders on matters related to data policy and practice;
- (f) Critical analysis of capabilities and gaps (systems, processes, people, networks, governance, issues of compliance);
- (g) Specification of expected deliverables, outcomes, milestones and key performance indicators for national WIGOS implementation;
- (h) Development of a National WIGOS Implementation Plan.

6.2.1 Development of a National Observing Strategy: Understanding national needs and priorities

Development of a National Observing Strategy will enable the NMHS and its national partners to better meet user needs and demands, and will help ensure that it has the best basis for planning its investment in systems, science and people. It will also allow the NMHS and its partners to make informed decisions, based on user requirements, for future planning purposes. The four key principles of the Strategy are: (1) demand- and user-driven products and services; (2) a phased approach to implementation; (3) effective partnerships; and (4) building on core strengths.

The Strategy will recognize the NMHS as a strategic national asset that contributes to the security of transport, food, water, energy and health (Key Pillars of the GFCS) in addition to being vital to sustainable development, climate change mitigation and adaptation, and disaster risk reduction. To that end, the National Observing Strategy should be well aligned with the overarching vision, mission and strategic plan of the NMHS. It should also set the scene for the partnerships that will be sought in implementing WIGOS.¹⁵

The National Observing Strategy provides the overall strategic framework for implementing WIGOS and should take into account the needs and goals of all data users and the broader environmental observing community, including the marine, atmospheric, hydrological and cryospheric observing communities. These may be considered partners in the implementation of WIGOS.

Examples of National Observing Strategies can be found at:

- (a) [Observing System Strategy](#) (Australia)
- (b) [Observations Strategy KNMI](#) (Netherlands)

6.2.2 Development of a National WIGOS Implementation Plan

The National WIGOS Implementation Plan (N-WIP) builds on the National Observing Strategy and specifies expected deliverables and outcomes, priorities, activities, milestones, timeline, resources, responsibilities and key performance indicators needed for:

- (a) Establishment of national (and subregional/cross-border when appropriate) WIGOS governance and coordination and management mechanisms for planning, implementation and coordination of the national observing systems in place;
- (b) Development of policy, legal and institutional frameworks with clearly defined roles and responsibilities of all stakeholders, and with well-organized coordination and collaboration mechanisms and principles;

¹⁵ See also WMO Integrated Strategic Planning Handbook (WMO-No. 1180).

- (c) Implementation of the WMO Unified Policy for the International Exchange of Earth System Data;
- (d) Establishment and enhancement of public-private partnerships;
- (e) Design, planning and evolution of the national composite observing system, including identification and mitigation of critical gaps (implementation of the national Rolling Review of Requirements (RRR));¹⁶
- (f) Development of a national contribution to the GBON;
- (g) Gap analysis of WIGOS-related systems, processes, people, governance, issues of compliance;
- (h) Sustained and standardized operation of national observing networks/systems in compliance with the Technical Regulations (WMO-No. 49), Volume I, Part I – The WMO Integrated Global Observing System, and the Manual on the WIGOS;
- (i) Operational implementation of WIGOS Metadata Standard through populating the [OSCAR/Surface](#) database and keeping its content up to date;
- (j) Operational implementation of WIGOS Station Identifiers;
- (k) Monitoring the availability and quality of observations through the national WDQMS, and taking corrective action as necessary (incident management);
- (l) Systematic and rigorous performance monitoring and evaluation of WIGOS capabilities;
- (m) Increased integration and free and unrestricted sharing of observations from NMHSs and non-NMHSs sources;
- (n) Development and implementation of a data and information framework;¹⁷
- (o) Implementation of modern data lifecycle management and practices;
- (p) Availability and protection of suitable radiofrequency bands required for meteorological and related environmental operations and research;
- (q) Development of an effective resource mobilization strategy;
- (r) Development of a risk management plan;
- (s) Development of a workforce plan or a capacity development plan of the staff managing and operating national observing networks/systems.

The N-WIP is intended to put the national WIGOS framework in place, not to fix all problems and issues. It is a tool to start planning observation improvements. It should be realistic and achievable.

6.2.3 Planning

Planning is the first step in the so-called [Plan-Do-Check-Act \(PDCA\) Cycle](#), whose chief aim is to ensure continued improvement of a given service or product, in the case of WIGOS observations flowing to the WMO community. In WIGOS implementation, it is important to

¹⁶ See *Manual on the WIGOS*, 2.2.2, and Chapter 5 of this Guide.

¹⁷ See example at http://www.bom.gov.au/inside/BoMDataFramework_Final.pdf.

maintain an integrated view of user requirements and corresponding capabilities based on the Rolling Review of Requirements (RRR) process¹⁸.

To fully embrace the WIGOS concept at the national level requires an integrated approach to the design, planning and operation of the full suite of national observing systems. This means, in effect, operation of a national composite observing system (that is, a system of systems) that is optimized to address diverse user needs as efficiently and effectively as possible and with just enough redundancy and overlap to provide resilience and continuity.

The implementation of a national RRR process will help Members understand and assess user requirements, define the characteristics of the observations required and design the system solutions that will deliver them; it is a tool for the coordinated evolution of NOS enabling Members to tackle those requirements in an integrated way.

A comprehensive strategic and operational planning process will then allow the development of staged approaches to the design, development and implementation of new and improved systems, processes and networks, supported by well-structured business cases and budget proposals. Budget shortfalls may of course limit or delay the achievability of the overall plans, but the information gained through the RRR process will still inform decisions on priority use of existing resources.

Planning includes close collaboration and coordination with all users to assess their requirements; a review of the existing components of NOS; an assessment of their adequacy in meeting current and future requirements; identifying future opportunities; prioritizing; and finally deciding on a strategy matched with resources.

Close collaboration and cooperation among the NMHS and other relevant national agencies; the establishment and implementation of appropriate mechanisms; and partnerships and data policy principles, while respecting ownership, are needed to meet WIGOS requirements at national level. This specifically refers to enhanced cooperation among meteorological, hydrological and marine/oceanographic institutions/services where they are separated at the national level, as well as to national implementation mechanisms for related international observing programmes such as the Global Climate Observing System (GCOS), Global Ocean Observing System (GOOS) and Global Earth Observation System of Systems (GEOSS).

In addition to meeting requirements at the national level, the Member needs to address international commitments as part of the design, development and implementation of NOS. Driving forces likely to impact on the design, operation and required deliverables of NOS in the future include:

- (a) Need for a holistic approach to planning and evolution of NOS and enhanced integration of its components;
- (b) Growing demand for meteorological services overall, in contrast to decreasing public funding to support the necessary infrastructure;
- (c) Greater emphasis on climate monitoring and services in addition to continued demands for weather-related services;
- (d) Increased requirements for quality management, standardization and interoperability, efficiency and cost-effectiveness;
- (e) Available or emerging technological opportunities.

¹⁸ See the *Manual on the WIGOS*, 2.2.4, with further details at <https://community.wmo.int/rolling-review-requirements-process>

The National WIGOS Implementation Plan should reflect the Member's national situation, in terms of the mandate of its NMHS, the requirements of the user community and the need to reach out to partners to develop an integrated observing system that meets national service needs. It should link the NMHS with its national partners for increased integration and free and unrestricted sharing of observations, including those from non-WMO sources.

There is no one-size-fits-all approach. WMO Members and their NMHSs differ in size and available resources, whether financial, technical or scientific, therefore, their N-WIPs will naturally differ both in content and style. While Members can learn from the plans and experiences of others, through case studies and workshops, they will be provided with additional WMO guidance materials to help them understand the various steps in the planning process.

In developing their national WIGOS implementation plans, Members should be guided by the Key Activity Areas (KAAs) of the WIGOS framework Implementation Plan (WIP) that are the building blocks of the WIGOS framework, as well as by the [Regional WIGOS Implementation Plan](#) of the respective regional association.

The WIGOS National Self-assessment Checklist was developed to help Members better understand the WIGOS framework to be implemented in their countries; to help Members assess their readiness for implementation and the challenges ahead of them, but especially to recognize that WIGOS is a natural change process. The Self-assessment Checklist is also useful in assessing Member's priorities, plans, gaps and capabilities, and will provide the basis for developing an achievable national WIGOS implementation plan.

Members are encouraged to draw on the WIGOS National Self-assessment Checklist; two examples (Australia and Switzerland) are available at: <https://community.wmo.int/implementation-examples>.

A wide range of other materials already exists to guide Members in relation to WIGOS, including the *High-Level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040* (WMO-No. 1334) and relevant plans for the Global Framework for Climate Services (GFCS), the Global Atmosphere Watch (GAW), the WMO Hydrological Observing System (WHOS), the Global Cryosphere Watch (GCW), and the Global Climate Observing System.¹⁹ Altogether, those materials help identify national priorities and gaps in observations, systems, processes and capabilities, and provide the basis for developing a national WIGOS implementation plan. Alignment of WIGOS plans with national planning for GFCS, Disaster Risk Reduction (DRR), the WMO Information System (WIS) and other WMO priorities has considerable advantages:

- (a) Ensuring that the specific observation requirements for national planning are factored in as effectively as possible;
- (b) Capturing efficiencies and synergies and avoiding duplication of efforts and potential conflict;
- (c) Optimization and alignment of capacity development and project opportunities;
- (d) Demonstration to stakeholders and donors of the professionalism and coherent approach of the NMHS.

6.2.4 Data management

Careful management of data and their associated metadata is a vital aspect of any observing network/system, with real-time monitoring centres as well as with delayed-mode analysis centres. A key component of such data/metadata management is non-stop monitoring of the

¹⁹ The corresponding links will be included in due course.

data stream with feedback and corrective action when needed. This implies timely quality monitoring of the observations by the monitoring centres and early notification (that is, incident management) to observing system operators and managers of both random and systematic errors, so that timely corrective action can be taken. Such an operational system is needed to track, identify and notify network managers and operators of observational irregularities, especially time-dependent biases, as close to real-time as possible.

6.2.5 Protection of the radio-frequency spectrum

Access to the radio-frequency spectrum is critical to the operation of WMO global infrastructure, which underpins the service delivery of all Members. The radio-frequency spectrum is a physically limited and increasingly contested resource, with emerging technologies continually raising demand.

To safeguard the availability of the radio-frequency spectrum for meteorological and related environmental operations and research, it is of prime interest for Members to engage with their respective National Regulatory Authorities (NRA) and to actively contribute to any matters related to the radio-frequency spectrum at the national, regional and international level, in particular regarding preparation for the International Telecommunication Union (ITU) World Radiocommunication Conference (WRC).

WMO has established a network of national focal points for radio frequency matters with the following aims:

- To enhance the capabilities of NMHSs and other institutions with relevant mandates worldwide in addressing radio-frequency related issues;
- To foster close communication between NMHSs and their respective NRA to ensure that they have a comprehensive understanding of the importance of and requirements for radio frequencies for meteorological and related environmental activities;
- To foster the development of new experts in the field of spectrum management from which the membership of the WMO Expert Team on Radio Frequency Coordination (ET-RFC) can be sustained, addressing capacity development and succession planning risks identified by ET-RFC.

National focal points for radio frequency matters will receive support from ET-RFC to gain the necessary expertise and skills to ensure that they can address the issues related to the radio-frequency spectrum in accordance with the Terms of Reference (Annex 1).

6.2.6 Resources

In a time of increasing demand for meteorological information and services and decreasing resources, it is of crucial importance to invest the available resources where they create the greatest benefit. The gap analysis of the RRR process will help identify such points.

The success of WIGOS implementation will depend critically upon ensuring adequate resources for both technical programme management and specific network needs. Data/metadata acquisition, processing and management systems that facilitate access, processing, monitoring, use and interpretation of the data with the help of associated metadata are of crucial importance.

It is also important to recognize that WIGOS activities are primarily the responsibility of the individual WMO Members and that the cost should be covered by national resources. WIGOS implementation requires planning, priority setting and committed effort over a considerable number of years. Members' experience has shown that substantial changes in the national observing system depend on considerable adjustments to resource commitments. Such adjustments are not easy without planning and priority setting with a long lead time.

6.3 CONCLUSION

Establishing a comprehensive “system of systems” that meets the observational needs of multiple users and applications areas requires effort, and each Member will need to assess the size of that challenge and weigh up the costs and benefits. Through the engagement of non-NMHS organizations in a national “system of systems”, the NMHS may consolidate and strengthen its role as the national meteorological authority, especially in areas where it may not already be firmly established, for example in climate monitoring and delivery of climate services. Integration does not mean that “one-size-fits-all”. Where opportunities exist to serve multiple needs with a single solution, real efficiencies can be achieved, but as a rule, integration is more about finding an optimum balance between needs and solutions.

As the integration process moves forward, gaps and shortcomings, incompatibilities, deficiencies in national observing system capabilities and duplication of efforts will be identified and addressed. This is the most cost-effective and efficient way to make better use of existing infrastructure and improve the timeliness, quality and utilization of observational information for enhanced services and decision-making.

ANNEX 1. TERMS OF REFERENCE OF NATIONAL FOCAL POINTS

1. NATIONAL FOCAL POINTS FOR THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM

The WMO Integrated Global Observing System (WIGOS) National Focal Points shall:

1. Take the lead in communications on WIGOS with the WMO Secretariat (WIGOS Branch in the Infrastructure Department and the WMO Regional Offices) and the relevant Regional Working Groups/Teams;
2. Monitor and report on the status of the national WIGOS implementation and initial operations, taking into account the guidance provided in the *Guide to the WMO Integrated Global Observing System* (WMO-No. 1165);
3. Report to the Regional WIGOS Centres, in coordination with the NFPs on the WIGOS Data Quality Monitoring System (WDQMS) and to the WMO Secretariat on issues and challenges that might impact the implementation and operations of WIGOS in the country/territory and seek advice;
4. Identify and follow-up on WIGOS-related training and capacity development needs;
5. Contribute to the design of the Global Basic Observing Network (GBON) and the Regional Basic Observing Network (RBON) and identify existing or new stations that could be committed by the Member to GBON and/or RBON, and take actions to reach such commitment; liaise with the Secretariat concerning GBON and with its relevant Regional Working Groups/teams concerning RBON;
6. Liaise with other WIGOS-related NFPs to support the integration of all WIGOS component observing systems, for example, through the WIGOS tools;
7. Coordinate the development of national schema(s) for the assigning of WIGOS Station Identifiers, across all WIGOS component observing systems.

Note: The list of NFPs is available on the [WMO website](#).

2. NATIONAL FOCAL POINTS FOR OSCAR/SURFACE

OSCAR/Surface National Focal Points shall:

1. Liaise with the WIGOS NFPs in the country/territory to ensure that all the operators of the relevant observing systems in the country/territory are aware of OSCAR and ready to make the required metadata routinely available in OSCAR;
2. Coordinate user account creation in OSCAR, in order to enable accredited users to manage within OSCAR the relevant metadata from the country/territory;
3. Promulgate the WMO Technical Regulations relevant to OSCAR, as well as the guidance and training materials necessary for an adequate use of OSCAR;
4. Make all efforts to ensure that all accredited users of OSCAR are well-trained to make the right use of the editing tools available in OSCAR;
5. Promote, in collaboration with the WMO Secretariat and in compliance with the required standards, the use of automatic, or semi-automatic, machine-to-machine transfer of information for insertion/updates of metadata within OSCAR, from the relevant observing systems of the Member;
6. Work closely with the established Regional WIGOS Centre (RWC) of the region/subregion;
7. Upon request, provide the WMO Secretariat and the RWC with an overview of the Member WIGOS metadata status in OSCAR;
8. Take, without any delay, actions in order to correct any erroneous and/or missing metadata identified in OSCAR, regarding the Member observing systems;
9. Collaborate with the relevant WMO working bodies and the Secretariat to perform the critical review and gap analysis at national and regional levels, using the OSCAR/Analysis tool.

Note: The list of national focal points is available on the [WMO website](#).

3. NATIONAL FOCAL POINTS FOR WIGOS DATA QUALITY MONITORING SYSTEM

WDQMS National Focal Points (NFPs) shall:

1. Liaise with the Member's OSCAR/Surface NFP to ensure that metadata from all stations exchanging data internationally are available and updated in OSCAR/Surface;
2. Provide timely answers to all queries and tickets sent by the respective RWC related to issues and incidents with observations from the Member;
3. Initiate and coordinate actions that need to be performed at a national level, related to issues and incidents with observations from the Member, in order to solve them as quickly as possible;
4. Promulgate nationally the WDQMS-related practices and procedures specified in the WMO [Technical Regulations](#) (WMO-No. 49), Volume I, along with any related guidance and training material;
5. Follow all the procedures agreed at a regional/subregional level in the context of the respective RWC;

6. Liaise with other relevant WMO regional centres in the region, and in particular with regional instrument centres and regional training centres, as appropriate, to find sustainable solutions for the issues and incidents identified by the WDQMS.

Note: The list of national focal points is available on the [WMO website](#).

4. NATIONAL FOCAL POINTS FOR RADIO FREQUENCY MATTERS

Radio Frequency National Focal Points should:

1. Serve as the national contact for, and contribute to, relevant radio-frequency related activities nationally, regionally and/or globally;
2. Promote the WMO positions on the relevant agenda items of the International Telecommunication Union (ITU) World Radiocommunication Conference (WRC), as developed by the Expert Team on Radio Frequency Coordination (ET-RFC), at the national level by:
 - a. Actively participating in spectrum management committees and activities led by their National Regulatory Authorities (NRAs), advocating for the WMO positions at relevant committees,
 - b. Ensuring their NRA is provided with a copy of the WMO's WRC Position Paper each time a new or revised position paper is approved.
3. Foster the dissemination of relevant radio-frequency guidance, recommendations, and other materials that are distributed by the WMO Secretariat to ensure that it reaches the relevant stakeholders within the meteorological community and beyond;
4. Engage with their respective NRAs to ensure that they have a comprehensive understanding of the importance of and requirements for radio frequencies for meteorological and related environmental activities, and seek NRAs support in the ITU Radiocommunication Sector (ITU-R) activities, in particular in the ITU WRC preparation process;
5. Participate in the national, regional and/or international activities on relevant radiocommunication regulatory issues and, in particular, to get involved in the work of relevant regional telecommunication organizations and ITU-R, especially ITU-R Study Groups 5 and 7 on Terrestrial (including radiolocation) and Science services, respectively;
6. Register adequately all radiocommunication stations and radio frequencies used for meteorological and related environmental operations and research with their NRA;
7. Inform the ET-RFC of any new radio-frequency requirements or usage to initiate appropriate international procedures to obtain the right to deploy and operate new equipment and then ensure their long-term protection. This information is crucial due to the long process to obtain international recognition.
8. Inform the ET-RFC of the outcomes of their domestic discussions with their NRAs that are relevant to the ET-RFC and its work. This could include raising awareness of domestic spectrum proceedings that may be of interest to the wider international meteorological community and beyond. This reporting mechanism aims to raise awareness among ET-RFC

members of national RF matters and regulatory proceedings that are of interest to the WMO and its Members.

Note: The list of National Focal Points is available on the WMO website

ANNEX 2. PLANNING AND MANAGEMENT TOOLS

1. THE PLAN-DO-CHECK-ACT CYCLE

The Plan-Do-Check-Act (PDCA) cycle is an efficient tool for continual improvement. The methodology applies to both high-level strategic processes and to simple operational activities. It consists of:

- (a) Plan: planning the improvement on the basis of the [gap analysis](#) (what needs to be done, where, when and how to do it; who should do it);
- (b) Do: implementing the plan;
- (c) Check: monitoring and measuring the results against the plan, requirements, policies and objectives;
- (d) Act: taking actions and measures to improve the process/performance.

Plan-Do-Check-Act is a continuous cycle that can be applied within any individual process or across a group of processes within the organization. Further information can be found at:

<https://asq.org/quality-resources/pdca-cycle>

<http://9001quality.com/plan-do-check-act-pdca-iso-9001/>

<http://9001quality.com/continual-improvement-process-iso-9001/>.

2. GAP ANALYSIS

The gap analysis is a technique for determining the steps to be taken in moving from a current state to a desired future state. It is also called “need-gap analysis” or “needs analysis”.

A gap analysis generally consists of five steps: (1) reviewing a current (as is) system; (2) determining the requirements of the proposed (future) system and (3) comparing the two in order (4) to determine the implications and (5) requirements in getting from one state (as is) to the other (future state). Key gaps identified in the observing capabilities will result in proposals for activities to fill these gaps, reflecting priorities and taking account of the resources available (see also: *Guidelines on the Role, Operation and Management of National Meteorological and Hydrological Services* (WMO-No. 1195)).

3. THE ROLLING REVIEW OF REQUIREMENTS

The Rolling Review of Requirements (RRR) described in the *Manual on the WMO Integrated Global Observing System* (WMO-No. 1160), Appendix 2.3, with further details online at <https://community.wmo.int/rolling-review-requirements-process>, is used to compare user observational requirements with the capabilities of present and planned observing systems to satisfy them. The process consists of five stages:

1. An ongoing review of user requirements for observations;

2. An ongoing review of current and planned observing system capabilities, including available or emerging technological opportunities;
3. A Critical Review of the extent to which the capabilities (stage 2) meet the requirements (stage 1) for each application area;
4. Development of Statements of Guidance of Earth System Application Categories based on (stage 3), identifying priorities for action to address gaps, impacts or limitations resulting from these gaps and to improve relevant observing systems; and
5. Development of High-Level Guidance for the Evolution of Global Observing Systems, providing Members with clear and focused guidelines and recommended actions.

The RRR process will issue new Statements of Guidance and High-Level Guidance periodically to be implemented in the management of national observing systems. It is a process directly linked to the Act step of the PDCA cycle.

The relationship between the RRR process and PDCA cycle is shown in the figure below.

Figure 6.1. The Rolling Review of Requirements and the Plan-Do-Check-Act cycle

7. GUIDANCE ON WIGOS DATA PARTNERSHIPS

7.1 INTRODUCTION

WIGOS provides a framework for WMO to define and manage weather, water, climate and other observations required for WMO Programmes and to support the broader interests of WMO Members. With an Earth system perspective, WIGOS is designed to manage observations from a diversity of surface- and space-based observing systems across physical domains. These observations are acquired by a variety of players with the aim of providing an integrated, composite set of observations that are well-managed, reliable and accessible to many users and are suitable for many service and science applications. An integrated and comprehensive set of observations across the atmospheric, terrestrial and oceanic domains is necessary to support the range of important national and global issues such as climate change, sustainable development, and human and ecosystem health. In a very simple way, data is at the core of everything that National Meteorological and Hydrological Services (NMHSs) do. Trusted, discoverable, interoperable and responsive data from different sources are converted into essential weather, climate, water and other environmental services.

The implementation of WIGOS is initially focused on the integration of existing WMO Observing Systems,²⁰ which are predominantly, though not exclusively, operated by NMHSs and their established partners. However, WIGOS also encourages and enables the integration of observations from new partners such as other governmental and non-governmental organizations, research institutes, volunteer networks, the private sector and individual citizens. It is known that useful observations of Earth system variables are being collected by these stakeholders, but their incorporation into WMO observing systems has been constrained by the lack of an integrating framework and by a variety of technical barriers. WIGOS now offers the framework and tools to enable these observations to be integrated, thus contributing more effectively to national and global interests.

²⁰ These include: the Global Observing System (GOS), the observing components of the Global Atmosphere Watch (GAW) and the Global Cryosphere Watch (GCW), the World Hydrological Observing System (WHOS), and WMO contributions to co-sponsored systems (Global Climate Observing System (GCOS), Global Ocean Observing System (GOOS), Global Terrestrial Observing System (GTOS)), the Global Framework for Climate Services (GFCS) and the Global Earth Observation System of Systems (GEOSS).

The implementation of WIGOS also presents an opportunity for Members to better coordinate and strengthen their national observing capabilities in support of their national priorities. WIGOS provides tools for the analysis of observation needs and gaps, and encourages NMHSs and other observing system operators to coordinate their efforts to address them. On behalf of Members, NMHSs promote and facilitate the adoption of WIGOS in their countries, and other observing system operators are invited to explore this opportunity with them.

7.2 PURPOSE AND SCOPE

This chapter is Part 1 of Guidance on WIGOS Data Partnerships with additional material to follow. It provides guidance on integrating observations from non-NMHS sources into WIGOS and addresses the mutual benefits of free and unrestricted data sharing and the challenges associated with such integration. It also highlights the roles and expectations of NMHSs in encouraging and facilitating the integration process.

This Part focuses on surface-based meteorological observations, although the principles and general guidance are broadly applicable to other types of observation. This initial focus was chosen because surface meteorological stations are considered to be the most numerous and widely available sources of additional observations and can, therefore, enhance overall national (and in turn global) observation sets. In parallel, several WMO communities (such as the Global Atmosphere Watch (GAW), the Global Cryosphere Watch (GCW), the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS) are leading the integration of related observations into WIGOS, including the incorporation of observations from partner organizations.

Currently, vast gaps exist over land and sea where essential surface-based observations are missing. In some parts of the world observations are either not made or not exchanged internationally, and in other parts they are not made or exchanged frequently enough.

In response, the Global Basic Observing Network (GBON), established through Resolution 2 (Cg-Ext(2021)) (see *World Meteorological Congress: Abridged Final Report of the Extraordinary Session* (WMO-No. 1281)) sets out an obligation and clear requirements for all WMO Members to acquire and internationally exchange the most essential surface-based observational data at a minimum level of spatial resolution and time intervals. GBON is a landmark agreement and represents a new approach in which the basic surface-based observing network, which is needed to feed numerical weather prediction (NWP) models with input data, is designed, defined and monitored at the global level.

Once fully implemented, GBON, a fundamental element of WIGOS, will significantly increase the availability of the most essential surface-based data. This will have a direct positive impact on the quality of weather forecasts and information and will enable all WMO Members to deliver better, more accurate and timely weather- and climate-related services to their constituencies.

7.3 INTENDED AUDIENCE

While primarily intended to support NMHSs in their national implementation of WIGOS, this chapter is relevant to both NMHS and non-NMHS audiences.

Sections 7.5 and 7.6 are intended primarily for Permanent Representatives with WMO, NMHS Directors, and senior managers serving as the national promoters and implementers of WIGOS. These sections contain the principles and general guidance for establishing and maintaining partnerships with operators of observing systems. Those principles are also of relevance to non-NMHS organizations considering a data partnership with their NMHS.

Section 7.7 is intended primarily for NMHS Observing System Managers in their role as technical leads and facilitators of national WIGOS implementation. This section provides

technical guidance on how to integrate observational data from other sources in compliance with the *Manual on the WIGOS*. This section is also of relevance to technical managers from non-NMHS organizations enabling them to understand the technical implications of sharing their observational data with an NMHS.

7.4 EXPLANATION OF TERMS

Within WIGOS, “observations” and “observational data” refer to the result of the evaluation of one or more elements of the physical environment. These terms include observational metadata – descriptive information about observations that is needed (a) to assess and interpret the observations or (b) to support the design and management of observing systems and networks. Observations and metadata may come in paper or electronic format, but now the terms predominantly refer to electronic data handled by information and communication technology (ICT).

In this publication, “non-NMHS observational data” refers to observations and metadata that are collected by organizations outside an NMHS. “Non-NMHS operators”, “non-NMHS providers” and “partners” refer to the organizations or individuals outside NMHSs that operate observing systems or networks. The nature of the relationship between an NMHS and a non-NMHS operator can vary widely, from a partnership for mutual benefit to a commercial contract, however, the generic term “partnership” is used in this publication to cover the full range of such relationships.

7.5 GUIDING PRINCIPLES AND RECOMMENDATIONS FOR NATIONAL COLLABORATION ON EARTH SYSTEM DATA

7.5.1 Free and unrestricted data sharing for mutual benefit

Integrating observations from diverse sources into WIGOS supplements NMHS observations and ultimately leads to better NMHS services and broader benefits for Members. Yet there must also be incentives for non-NMHS operators to share their observations with an NMHS and potentially with the international WMO community. A key principle of successful and sustained observation partnerships is the recognition of mutual benefit based on common organizational interests and strengthened collaboration.

The drive for increased national collaboration on Earth system data is similar in nature to the drive for international exchange of data, and it can be articulated simply as follows: data sharing creates mutual benefits for all stakeholders.

Over the last two or three decades, Earth system data have become uniformly recognized as potentially being very valuable economically. More recently, various national and international economic analyses have demonstrated that the highest economic impact of Earth system data is obtained with free and unrestricted data policies, with the benefits of sharing all available Earth system data found to far outweigh the costs. These costs are represented by the loss of prospective revenue from selling the data to users willing and able to pay for them.

The sustainability of the basic infrastructure for data collection, processing and dissemination should be considered the responsibility of the Member as a whole, and not just of its NMHS.

Compliance of all national entities with Resolution 1 (Cg-Ext(2021)) – WMO Unified Policy for the International Exchange of Earth System Data (*World Meteorological Congress: Abridged Final Report of the Extraordinary Session (2021)* (WMO-No. 1281)) should be seen as essential for maximizing the socioeconomic benefits of Earth system data.

Members are strongly encouraged to:

- Undertake necessary actions to promote alignment of national policies and regulations concerning Earth system data sharing and exchange, nationally and internationally, in line with the policy promulgated through this resolution;
- Provide full transparency on conditions of use and reuse when such conditions apply to exchanges of recommended data;
- Accommodate the need for users of recommended data to respect the conditions of use set by the owners of the data, as this will help to facilitate access to the data;
- Facilitate the exchange of data from all stakeholders and sectors at the international level when emergencies and natural disasters occur;
- Build partnerships to enhance the exchange of Earth system data amongst national and regional stakeholders in order to improve integration of data across disciplines and domains;
- Strengthen effective coordination with relevant WMO partners and stakeholders on matters related to data policy and practice and encourage them to adopt similar policies and practices concerning the free and unrestricted exchange of their relevant data in support of WMO programmes.

7.5.1.1 Provision and exchange of core data

In applying the WMO Unified Policy for the International Exchange of Earth System Data:

- All stakeholders should commit to comply with relevant national and international legislation and policies with respect to both data provision and avoidance of anti-competitive behaviour;
- Members should ensure that users from all sectors — public, private and academic — are granted free and unrestricted access, without charge and with no conditions on use, to the declared core data specified in Resolution 1 (Cg-Ext(2021));
- As articulated in Resolution 80 (Cg-18) – [Geneva Declaration – 2019](#) (*World Meteorological Congress: Abridged Final Report of the Eighteenth Session* (WMO-No. 1236)), engagement between public and private sectors should be conducted in a transparent way and should be aimed at enhancing mutual benefits to both public and private sectors for the benefit of society;
- Members should ensure that, in the case of core data purchased from private sector data providers, such data sets are appropriately licensed for free and unrestricted international exchange;
- The technological solutions for access to the internationally exchanged core data should be fully compliant with the principle of free and unrestricted access²¹;
- Permanent Representatives of Members, who are responsible for authorizing users of the WMO Information System (WIS) in accordance with the *Manual on the WMO Information System* (WMO-No. 1060)), should authorize access to core data with no obstructions.

²¹ At the time of adoption of Resolution 1 (Cg-Ext(2021)) (*World Meteorological Congress: Abridged Final Report of the Extraordinary Session* (WMO-No. 1281)), the main access to core data provided by Members was through the WMO Information System (WIS); other access options may also be available (ftp servers or similar).

7.5.1.2 Provision and exchange of recommended data

While Members are encouraged to apply the principle of free and unrestricted international exchange to the recommended data they provide, such data sets may have conditions on their use, for example, for commercial purposes. The originators of such conditions should follow the following general principles:

- Fair and transparent setting of the conditions on use;
- Level playing field – the same rules to apply to public and private entities using the data sets for commercial purposes;
- Avoidance of anti-competitive behaviour (such as blocking access to public data with a view to creating competitive advantage for the commercial activities of the public sector entities or their spin-offs) should be regarded as a non-compliance with the high-level policy (see the Geneva Declaration);
- Members should make available a catalogue of recommended data to facilitate their use under the established conditions of use. The experience of Economic Interest Grouping of the National Meteorological Services of the European Economic Area (ECOMET) presents a good practice for such cataloguing as well as for harmonization of the conditions of use imposed by different countries in the same geographic region;
- In exchanging data with conditions on use, the conditions which have been posed by the originator of the data should be made known to initial and subsequent recipients.

7.5.1.3 National Meteorological and Hydrological Services

National Meteorological and Hydrological Services are typically supported by their national governments in establishing and operating an observing system to carry out their core mandate. Depending on the national situation, the NMHS is often responsible for weather and climate observations, and may also be responsible for hydrologic, ocean, and other observations. The increased demand for hydrometeorological services and products at ever finer spatial scales has led to a growing demand for spatially denser and more integrated observations across these domains. At the same time many NMHSs are facing increasing logistical and economic challenges in supporting their current observing systems, and they may be unable on their own to deploy observing networks that meet those new requirements. In this context, it is logical for NMHSs to look to other operators as sources of observational data. More broadly, Member governments are continually seeking more cost-effective approaches to meeting their needs, including opportunities such as WIGOS to maximize the value of existing national observing capabilities.

The overarching goal in integrating more observational data within WIGOS is to keep pace with user expectations and to improve the quality and value of Members' services, products, and science. Beyond national interests, there is also the broader goal of improving the quality of global services and science through the international exchange of observational data across WMO. In this context, the incentives for NMHSs to enter into observational data partnerships include:

(a) Filling observation gaps²²:

- (i) Increasing the density and timeliness of observations especially in high-impact locations or observation-sparse regions, or for parameters not observed by the NMHS;

²² See the example of establishing a successful public-private partnership: MeteoSwiss Collaborates with the Private Weather Company MeteoGroup, the Largest Operator of a Network of Private Weather Stations in Switzerland

- (ii) Improving access to real-time observations of current conditions for situational awareness and nowcasting;
- (b) Cost-efficiency:
 - (i) Gaining access to observations at no or low cost;
 - (ii) Gaining access to observing sites with power and communications infrastructure;
 - (iii) Gaining access to non-NMHS secure and monitored observing sites (for example, to prevent vandalism);
 - (iv) Reducing infrastructure and operating costs through contracting out of station operations;
- (c) Strengthening national observing capabilities:
 - (i) Establishing a more complete and robust national observing system to support a wide diversity of NMHSs and other national applications;
 - (ii) Improving observation quality assessment and quality control by using redundant and/or diverse sources of observations;
 - (iii) Raising the overall quality and reliability of national observations through outreach to non-NMHS operators, training, promotion of standards and, potentially, national policies or regulations;
- (d) Strengthening NMHS leadership and visibility:
 - (i) Exercising and demonstrating national leadership through broad engagement and coordination, including with the general public;
 - (ii) Strengthening the commitment of NMHSs and the effectiveness of their mission;
 - (iii) Reducing complaints or criticism, through active engagement with other organizations and the general public.

7.5.1.4 Non-NMHS operators

Non-NMHS operators have invested in observing systems to meet the specific needs of their organizations or for other reasons. Many also recognize that observations may benefit the broader community. Non-NMHS operators may include other governmental organizations, research institutions, the commercial sector, academia, voluntary organizations and private citizens. The needs of these operators vary widely depending on the type of organization and its needs. Consequently, the incentives to share observational data with NMHSs or internationally with WMO Members are also very diverse.

The incentives for non-NMHS operators to enter into observational data partnerships include:

- (a) Operational requirements:

Observational data that are shared with NMHSs and WMO improve the weather, water and climate products and services that support their operational needs or interests;
- (b) Access to other observations:

Observational data are provided to NMHSs in order to leverage access to a larger pool of observations from other national sources, or to access the global observational data exchanged among WMO Members;

(c) Business opportunity:

The commercial sector wishes to sell or license observational data to NMHSs for profit or for cost recovery;

(d) Association with a public-good programme:

The visible contribution of observational data to a recognized national or international public-good programme lends significant credibility to many observing programmes and is frequently leveraged to justify funding;

(e) Quality assurance and observational data management:

Observational data are provided in exchange for authoritative quality assessment by the NMHS, and/or for long-term preservation in climate archives;

(f) Technical support:

Observational data are provided in exchange for authoritative guidance and assistance from the NMHS in technical matters such as equipment, station configurations, standards, calibration and maintenance;

(g) Volunteerism:

Observational data are provided by organizations or citizens as a contribution to the public good or for scientific record;

(h) Operational support:

Organizations seek to transfer station operations to NMHSs in cases where they may have resources to buy equipment, but have no technical capability to operate it.

Many observational data partnerships are voluntary and rely on the mutual interest and goodwill of the participants to make the partnership work. Nevertheless, well-documented agreements to define and manage the partnership are common and are highly recommended. These arrangements can vary greatly in content, formality and enforceability, ranging from best-effort Memorandums of Understanding to more formal Letters of Agreement or legally binding contracts. Section 7.6.4 – Establishing and sustaining observation partnerships – provides more details.

7.5.2 WIGOS observational data quality

Quality is one of the most frequently expressed concerns about observations from non-NMHS sources. Knowledge of the quality of observations is an important factor in the credibility and authority of NMHS and WMO products and services, so the use of other observational data without sound knowledge of the collection and processing procedures is considered by many as a risk to the overall quality of NMHS and WMO Programmes.

WMO has historically used a “controlled and documented quality” approach to observational data quality. Quality is managed through well-defined, end-to-end technical standards and recommended practices to which NMHSs and other operators are expected to adhere. Thus quality is controlled through a rigorous process. Many non-NMHS operators are unaware, unable or unwilling to adhere to WMO quality requirements as they are often considered too stringent or expensive for their internal needs. As a result, the real quality of much non-NMHS observational data is largely unknown.

On the other hand, there are many non-NMHS organizations that operate well-controlled systems to high standards and provide high-quality, well-documented observational data, for example for aviation, road weather, wind energy, climate and hydrological applications. Some

organizations also operate under the ISO/IEC 17025:2005 standard (General requirements for the competence of testing and calibration laboratories) to satisfy their business requirements. Another example of an observational data quality standard is [Quality Assessment Using METEO-Cert – The MeteoSwiss Classification Procedure for Automatic Weather Stations](#) (Instrument and Observing Methods Report No. 126) which is applied to non-NMHS operators' stations at the time of inspection.

To address the issue of observational data quality, WIGOS has adopted an approach based on the principle of documented known quality. This approach seeks to maximize the descriptive metadata associated with an observation in order to allow the user to understand how the observational data was produced and to assess its appropriateness for the intended application. The user, for example, will be able to assess whether an observation meets aviation standards or is suitable for long-term climate monitoring.

This approach is adaptable to a range of observing systems and practices, and accommodates the real-world variability of observational data from different observing system operators. This is especially helpful in supporting operators where compliance with equipment and operating standards is uneven or lacking. The approach also supports the informed use of the same observations for multiple applications. The principal tool for supporting the "known quality" approach is the *WIGOS Metadata Standard* (WMO-No. 1192) (see also 7.7.2 below).

7.5.3 Roles and responsibilities

The successful integration and use of observations from multiple sources require collaboration and coordinated activities across several entities within WIGOS. These include NMHSs, regional associations, Regional WIGOS Centres (RWCs) and the non-NMHS partners that contribute data to WIGOS.

7.5.3.1 National Meteorological and Hydrological Services

As national authorities for weather, water and climate information, NMHSs have a national leadership role in the continued improvement of national observing capabilities that build on WIGOS principles, practices and procedures.

The principal role of NMHSs with respect to non-NMHS observations includes:

- (a) Leading the implementation of WIGOS at the national level through the development of a National Observing Strategy and a National WIGOS Implementation Plan;
- (b) Managing the assignment of WIGOS Station Identifiers for national stations;
- (c) Engaging and encouraging national non-NMHS operators to contribute their observations to a consolidated pool of observational data for the benefit of all at the national, regional or global level;
- (d) Articulating and exploring with non-NMHS operators the benefits of contributing and sharing their observational data with NMHSs and WMO Programmes;
- (e) Developing and maintaining agreements with non-NMHS operators using suitable mechanisms (such as Memorandums of Understanding or contracts) which articulate the benefits of the partnership and specify the roles and responsibilities of the participants;
- (f) Encouraging and supporting the use of WIGOS standards (such as the WIGOS Metadata Standard) and tools (such as [OSCAR/Surface](#)) to the greatest possible extent for national observations;
- (g) Assessing the relevance, quality and sustainability of non-NMHS observations to support national and global programmes;

- (h) For observations of high global value, helping non-NMHS operators to be compliant with the WIGOS Metadata Standard to enable metadata compatibility;
- (i) Supporting outreach and training related to WIGOS, for instance, on WIGOS standards, recommended practices and procedures and mechanisms for observational data exchange;
- (j) Supporting effective observational data management and/or observational data sharing;
- (k) Encouraging and supporting the implementation of adequate cyber security mechanisms.

7.5.3.2 Regional associations and Regional WIGOS Centres

Regional associations and Regional WIGOS Centres are uniquely positioned to support WIGOS implementation beyond national borders.

The principal role of regional associations with respect to non-NMHS observations includes:

- (a) Transiting the Regional Basic Synoptic Network (RBSN) and the Regional Basic Climatological Network (RBCN) to a Regional Basic Observing Network (RBON);
- (b) Identifying issues and opportunities of regional importance where cross-border coordination of non-NMHS observations would be beneficial (for example, across international watersheds; see La Plata Basin WIGOS-Southern South America (WIGOS-SAS case study));
- (c) Establishing regional/subregional coordination mechanisms to support cross-border WIGOS activities, including the coordination of observational data from non-NMHS sources, and, potentially, coordinating the response to observational data issues and incidents identified by the WIGOS Data Quality Monitoring System (WDQMS).

In addition, Regional WIGOS Centres will play a critical role in advancing the implementation of WIGOS within their region (or subregion) and will provide regional coordination and technical support to Members.

7.5.3.3 Non-NMHS partners

The contribution of observations by non-NMHS organizations is generally voluntary, but partners are expected to support an effective WIGOS. National Meteorological and Hydrological Services are encouraged to support non-NMHS partners in performing their role.

The principal role of non-NMHS partners includes:

- (a) Identifying and sharing observations of relevance to meet national needs and support national priorities, and potentially sharing observations internationally;
- (b) Providing WIGOS metadata to ensure the appropriate use of the observations;
- (c) Maintaining WIGOS metadata up to date via OSCAR/Surface, in collaboration with NMHSs;
- (d) Developing and maintaining an agreement with NMHSs (or other collaborating organizations) which articulates the benefits of the partnership and specifies the roles and responsibilities of the participants;
- (e) Implementing to the greatest extent possible NMHS, national and WMO standards and recommendations regarding the collection of observations and data management.

7.6 GENERAL GUIDANCE

7.6.1 Non-NMHS observational data of relevance to WIGOS and national observing systems

The overall aim of gaining access to observational data from non-NMHS sources is to increase the number of relevant observations to support Members' and WMO Programmes. But what kind of observational data should be sought and what factors should be considered in assessing non-NMHS observational data opportunities?

7.6.1.1 WIGOS requirements

The observational requirements to support WMO Programmes are established through the [Rolling Review of Requirements \(RRR\)](#), and critical gaps in the observing system are identified in Statements of Guidance. For Members, the key reference for WIGOS observational requirements and systems is the Observing Systems Capability Analysis and Review tool (OSCAR).

The [OSCAR/Requirements](#) database is the official repository of [requirements](#) for the observation of geophysical [variables](#) in support of all activities of WMO and its various co-sponsored programmes. The database provides a listing of the observational requirements for all WMO application areas as listed in the *Manual on the WIGOS*. The database also provides a description of geophysical variables, as well as minimum and desirable figures for the uncertainty of the measurement, resolution, frequency and timeliness.

The OSCAR/Surface module is the official repository of WIGOS metadata for all surface-based observing stations and platforms registered with WMO. The module provides a description of the observing sites (through WIGOS metadata) and an interactive map to display the geographic location of those sites. It is mandatory that stations be registered in OSCAR/Surface for observations to be exchanged internationally.

These tools may also be used to support assessments of the adequacy of existing observing systems to meet the needs of specific application areas, and to identify parameter and geographic gaps. Future releases of OSCAR are planned to include some level of automated analysis tool to provide further assistance with such assessments.

7.6.1.2 National observational requirements

WMO Members frequently have observational requirements beyond those specified in OSCAR in order to support national programmes and priorities. Observations are typically required to provide more geographically-detailed information or to support applications of high national impact such as those concerning agriculture, transport and flood forecasting. The requirements are driven by the needs of the specific application, the local environment and climatology, and by the national relevance of the application.

National or local observational requirements may or may not be formalized, but local relevance is often an incentive for non-NMHS organizations to establish their own observing capabilities – for instance, for agriculture or water management agencies. As a result, existing non-NMHS observing systems are often already well aligned with national or local interests and likely to be of high relevance to the NMHS as well. Such observations may also help address gaps in WMO requirements, and the opportunity for international exchange of these data should be sought. Citizen-operated or other stand-alone observing sites may also supplement the observations from more formal institutional partners.

7.6.2 Data use and sharing

As signatories to the WMO Convention, Members of the Organization have committed to "facilitate worldwide cooperation in the establishment of networks of stations for the making of

meteorological observations as well as hydrological and other geophysical observations related to meteorology” (from *Basic Documents No.1*, Convention of the World Meteorological Organization, Article 2 (a)).

Through their adoption of Resolution 1 (Cg-Ext(2021)) – WMO Unified Policy for the International Exchange of Earth System Data (*World Meteorological Congress: Abridged Final Report of the Extraordinary Session* (2021) (WMO-No. 1281)) (hereinafter “the Unified Data Policy”), Members have committed to establishing the general framework for the free and unrestricted international exchange of weather, climate, water and related environmental data. Approval of the Unified Data Policy provides a comprehensive update of the policies guiding the international exchange of weather, climate, water and related environmental Earth system data between WMO Members. The new policy reaffirms the commitment to the free and unrestricted exchange of data, which has been the bedrock of WMO since it was established in 1950. Specifically for observations, exchange is a must, not a choice, in order for them to have an impact. Even omitting to share observations across sectors at a national level will limit the societal and economic benefits that might otherwise be achieved.

The Unified Data Policy lays out the agreement between WMO Members on the overall principles and scope of the international exchange of Earth system data. Members have a role and responsibility to adapt to and implement the Policy, as both the WMO Convention and the WMO Unified Data Policy recognize the sovereign rights of the Members to decide which data will be exchanged, and how. A policy for the unification of data implies new partnerships within each Member State or Territory.

Alongside these long-standing commitments, WMO Members also approved the *Manual on the WIGOS*, which in its Annex 2.1 lists the observing network design principles. Principle 9 explicitly states that observational data should be made available to other WMO Members: “Observing networks should be designed and should evolve in such a way as to ensure that the observations are made available to other WMO Members, at space-time resolutions and with a timeliness that meet the needs of regional and global applications.”

It is clear, therefore, that the case for increasing the amount of observational data that is shared is very strong, and is indeed the underpinning infrastructure on which the services of NMHSs are built. It is also clear, however, that there remain significant barriers to the free exchange of observational data. A foundational principle of WIGOS is to expand the global observing systems beyond those historically operated by NMHSs and to include networks operated by other entities, public as well as private. These additional networks may operate under a wide range of data policies:

- Some governments have committed to releasing taxpayer-funded data under an open licence, either through the auspices of an Open Data Charter or through an equivalent instrument. This simplifies the use and exchange of data, including observational data, from these sources because there are few restrictions on use or reuse.
- Private operators are increasingly offering their observations (typically surface-based observations, GPS-Radio Occultation and aircraft data) to NMHSs for use in the generation of products and services. The license terms are typically more restrictive than those in the above category and they may not allow onward sharing and exchange. Members are encouraged to seek licence terms that support at least Members’ obligations regarding the exchange of observational data and, wherever possible, permit the open or broadest exchange.
- There has been a significant increase in the amount of observational data generated by private citizens in recent years. Data policies are often imposed by the operators of the data portal to which the individual chooses to submit their observations (for example, the UK Met Office [WeatherObservationsWebsite](#) (WOW), also used by the Australian Bureau of Meteorology). The sharing of these observational data amongst NMHSs can be challenging, however the observations are often free to view and download via the web.

As NMHSs consider how best to implement WIGOS in their national context, a comprehensive assessment should be conducted to understand what observational data could be available to support national interests and priorities. This could then shape a national Implementation Plan to use existing partnerships, create new partnerships where necessary, and ensure that the benefit of these observations can be realized.

7.6.3 Legal considerations (liability)

Many non-NMHS operators that contribute observations to NMHSs or WMO Programmes do so for the public good on a voluntary and best-effort basis. In general, these contributing organizations expect that they will not incur any legal risks as a consequence of any incorrect or missing observations. This is considered a reasonable expectation and should be a principle supported by NMHSs. For instance, the operator of a Voluntary Observing Ship should not risk a legal claim for third-party liability in the event that inaccurate or missing observations were a contributor in some way to a marine incident. If voluntary contributors of observational data were required to assume legal risks from their observations, this would limit their willingness to contribute and consequently reduce the benefits to all.

The WIGOS metadata will help users to assess the limitations and appropriate uses of observational data, while NMHS quality control procedures and the WIGOS Data Quality Monitoring System will seek to identify issues with the quality and the availability of observations. But the risk of faulty decision-making and legal action as result of flawed observational data provided by an external operator is still possible.

Most Members, their NMHSs and other governmental organizations are protected from such liabilities by national regulations. This immunity, however, cannot normally be transferred to non-governmental organizations, so NMHSs should seek to find mechanisms within their national laws to reduce the risk of liability for non-governmental partners, in order to obviate this potential barrier. For data that may be acquired and subsequently distributed by the NMHS through a partnership agreement, it may be possible, through the agreement, to transfer those risks to the government or to otherwise limit the risks for external partners.

There is a second dimension to liability to be considered in observational data partnerships. Participants may wish protection in the event that an action by one participant causes damage to the other, for instance, physical damage to equipment. Between agencies of the same government these risks are often assumed by the participants, or mechanisms for recourse are clearly defined in advance in a partnership agreement. For partnerships with non-governmental operators, clear definitions and limitations of liability should be included in the agreement, although NMHSs may wish to consider liability only in the event of misconduct or wilful negligence (versus accidental damage) in order to minimize barriers to cooperation. For example, MeteoSwiss has successfully incorporated issues of liability in the Terms and Conditions of its agreements with its non-NMHS partners.²³

7.6.4 Establishing and sustaining observation partnerships

Section 7.5 identifies mutual benefit as a core principle and summarizes the incentives for NMHSs and other operators to enter into a partnership. While observational data provided by partners are often thought to be free or low cost, NMHSs will nevertheless have to consider the value, internal costs and sustainability of such arrangements. Similarly, commercial observations will raise questions of value for money, restricted-use licensing and sustainability.

The Australian Bureau of Meteorology (BoM) has developed a [framework](#) for the incorporation of non-NMHS observations into their operations. The framework includes a practical

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<http://www.meteoswiss.admin.ch/home/measurement-and-forecasting-systems/land-based-stations/automatisches-messnetz/partnernetze.html>

step-by-step process to assess, approve and manage these observational data. A summary of this process is presented in the annex to this chapter.

The process is relevant for NMHSs seeking observations from non-NMHS sources, as well as for NMHSs that are approached by non-NMHS operators offering their observations.

7.6.5 Commercial arrangements

An alternative mechanism to acquire observations from non-NMHS sources is through supply arrangements with the commercial sector. These are formal contractual agreements, in contrast to the cooperative arrangements with voluntary partners. Commercial arrangements may be developed with companies whose primary business is selling meteorological observations and services, or with companies that collect meteorological observations to support their own business activities (for example, transportation, agriculture, dam operations) and then offer to sell them as a supplemental source of revenue. The commercial sector can have strong technical capabilities and can often be more agile than governmental organizations in offering modern observing technologies, so it may be an attractive option for establishing or enhancing observing capabilities. A commercial arrangement may be for observational data only (i.e. a “data buy”) or may include more comprehensive services such as the supply of observing equipment, installation and maintenance, quality assurance and observational data management.

Should NMHSs choose to use a commercial arrangement, the following should be considered.

7.6.5.1 Purpose of the network

Commercial networks may be developed independently or collaboratively. Independent networks are set up for a specific business purpose by the commercial operator that is not connected to the NMHS. For example, a beverage bottling company may develop a network to monitor the availability, quantity and quality of the water they sell. They may be willing to share their observational data with the NMHS, but may not consider any additional technical requirements such as the WIGOS Metadata Standard. They may also impose restrictions on use and redistribution of the data. The NMHS generally incur little or no implementation or operational risk, but the risk of data availability can be high if the business requirement of the operator is not sustained, or if release of the observations negatively impacts a commercial advantage.

Collaborative networks are set up to meet the specific technical and operational needs of the NMHS, while leveraging the infrastructure and technical capabilities of a commercial partner to obtain observations in a more cost-effective fashion or with less implementation or operational risk for the NMHS. These collaborative networks can, therefore, more easily meet WIGOS requirements. For example, a private company may already have sites, telecommunications infrastructure and the technical capacity to develop and operate an observing network to NMHS specifications. Collaboratively developing this network enables a “data buy” arrangement for the NMHS. The risk of implementation and operation is transferred to the private partner, while data quality can be monitored to meet NMHS specifications. Longer-term agreements increase the sustainability of such partnerships for both parties.

7.6.5.2 Long-term value

When assessing the value of a commercial arrangement, the long-term costs to the NMHS must be considered. These include the cost of establishing the capability within the NMHS itself, the duration of the contract, any supplemental costs (for example, telecommunications, land lease) and ownership and maintenance of the equipment at the end of the contract. The decision to proceed with a commercial supply arrangement should be supported by a sound business case which examines all costs, risks and comparative assessments of alternatives, if available. It is recommended that performance requirements (such as availability of observations, timeliness and quality) be specified in the statement of requirements. In a commercial contract, enforceable penalties for non-performance may also be considered.

7.6.5.3 Ownership and use

A key consideration is ownership of the observational data and metadata, and any constraints on their use and sharing. Often, the ownership and intellectual property rights of commercial observational data remain with the company, and a licence is provided to use the observations for specific purposes. For instance, the observations may be used internally by an NMHS to produce forecasts and climate analyses, but the observational data itself may not be sharable with others, including other NMHSs. The value of sharing observations in the national and international context is universally recognized, and Members are encouraged to carefully consider the terms of commercial arrangements and whether they support WMO Resolutions and data sharing principles.

The duration of the licence is also an important consideration when the commercial observations are to be archived for the climate record. Data supply arrangements should specify the right to store and use the data in perpetuity, not just for real-time use or for the duration of the supply arrangement. Similarly, if the supply arrangement includes proprietary data management or data access tools, provisions to access the data beyond the validity of the contract should be considered. Data formats and processing systems should be built on open standards/open source to enable ongoing access to observational data and tools. It is recommended that closed, proprietary formats and tools be avoided.

7.6.5.4 Sustainability

Because commercial contractual arrangements are normally of limited duration (for example, 5–10 years), consideration should be given to the long-term sustainability of the observations, both to support current NMHS operations and to maintain an uninterrupted climate record. Furthermore, the commercial providers themselves may cease operation during the period of the contract, or may be unable or unwilling to renew the contract at the end of the term.

To mitigate these risks, the following should be considered in the supply agreement:

- (a) Mechanisms for the transfer of equipment to the NMHS at the end of the contract or at the end of company operation;
- (b) Long-term financial planning to sustain an observing capability beyond the current contract, including periodic refresh of the technology;
- (c) Upkeep of technical capability within the NMHS to ensure operation, maintenance and life cycle management of equipment, where required;
- (d) The commercial operator's business environment in order to assess the risk that the operator may suddenly modify the technical implementation, increase prices or cease operations altogether.

7.6.5.5 Accountability

Public accountability for the quality and authority of observational data will normally rest with an NMHS, even if it chooses to outsource the supply of data through a commercial arrangement. Careful consideration should be given at the beginning of the commercial arrangement to the equipment specification, quality assurance measures and oversight of the services to protect this public accountability.

7.7 TECHNICAL GUIDANCE

After agreement is reached between an NMHS and a non-NMHS partner, several technical matters need to be addressed to enable the exchange and management of the observational data. These include the assignment of WIGOS station identifiers, the collection and

maintenance of WIGOS metadata, the technical mechanisms for the exchange of observational data, data management and archiving and issues of cyber security.

The WIGOS-related regulatory and guidance material does not address technical matters of data processing and data management. However, technical matters of specific relevance to WIGOS observational data partnerships are presented here for completeness.

7.7.1 WIGOS station identifiers

Guidance on the format and use of WIGOS station identifiers is provided in Chapter 2 of this Guide. In general, Members issue identifiers to national stations, including those operated by entities outside the NMHS. The NMHS has a coordination function in the management of station identifiers in order to avoid confusion or duplication.

WIGOS station identifiers are mandatory for stations to be registered in OSCAR/Surface (i.e. for the data to be exchanged internationally).

The structure of WIGOS station identifiers essentially provides for a limitless number of codes and is well suited to supporting both NMHS and non-NMHS stations. Because there are no constraints on the number of available codes, the new standard provides the opportunity to use a single, consistent station identifier scheme across all observing systems in a country regardless of operator. This could unify and simplify the tracking of national observing capabilities and could reduce the complexity of the supporting data management and processing systems. National Meteorological and Hydrological Services should consider a nationally-coordinated approach when WIGOS station identifiers are assigned, including to non-NMHS operators.

The process for issuing station identifiers to non-NMHS stations is the same as for NMHS stations. Non-NMHS stations that were previously registered in *Weather Reporting* (WMO-No. 9), Volume A, are migrated automatically to OSCAR/Surface. Non-NMHS stations that were not previously registered must be registered with a new WIGOS station identifier.

7.7.2 WIGOS metadata

The purpose of WIGOS metadata is to provide the details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to the interpretation of observations, as well as to the management of the station and observing programmes. As noted earlier, WIGOS metadata are essential to support the WIGOS principle of “known quality”. Figure 7.1 summarizes WIGOS metadata principles and content, and what is expected of Members.

Figure 7.1. Overview of the WIGOS Metadata Standard

For observations to be exchanged internationally, metadata need to adhere to the *WIGOS Metadata Standard* (WMO-No. 1192) and be registered in OSCAR/Surface. This requirement applies equally to observations from NMHS and non-NMHS stations.

The *WIGOS Metadata Standard* (WMO-No. 1192) is comprehensive, as it is designed to meet a broad range of WMO operational and scientific requirements, and the scope of the information required to fully comply with the standard is substantial. The effort required in collecting and maintaining this information is significant and requires careful planning and resourcing. This may cause reluctance in some non-NMHS operators.

To facilitate compliance, the WIGOS Metadata Standard has included a certain degree of flexibility:

- (a) Optional elements which “should” (vs “shall”) be reported;

- (b) Some mandatory elements may be reported as “inapplicable” or “unknown” with an explanation as to why the information is not available.

These options can be used to maximize the international exchange of observations, although progress towards complete metadata is always encouraged. National Meteorological and Hydrological Services can play a key role in assisting observation providers in complying with the standard. Among the actions NMHSs should consider with partners are:

- (a) Raising awareness of the WIGOS quality principles, the WIGOS Metadata Standard, and their benefits;
- (b) Providing expertise and assistance to partners in the collection of WIGOS metadata, including periodic review and update;
- (c) Metadata entry and maintenance in OSCAR/Surface on behalf of the partner;
- (d) Nominating the partner as a station contact in OSCAR/Surface for a defined set of stations.

The international exchange of observations may not be possible for reasons of quality, reliability or data ownership, or there may not be a strong international demand. For instance, observations from a national energy company might be made available for internal use by the NMHS to support national forecast products, but they might not be authorized for redistribution outside the NMHS. Even if it is not desirable or feasible to exchange observations internationally, NMHSs and observing partners are still encouraged to follow the WIGOS Metadata Standard as a consistent tool for a coordinated national observing system and to develop its use among non-NMHS operators to the extent possible.

When the international exchange of observational data is not planned, NMHSs can assist their partners in the national exchange of observations with an initial sub-set of WIGOS Metadata Standard elements, which over time may grow to become fully compliant and eligible for international exchange. This approach will increase overall compliance and awareness of the standard, facilitating the international exchange over time.

In assessing what initial sub-set of WIGOS Metadata Standard elements may be appropriate for national applications, it is useful to consider the different uses of observations and the varying levels of quality required of each application: observational data for a safety-critical use (such as aviation) or climate monitoring, for example, require a much higher level of quality.

7.7.3 OSCAR/Surface – WIGOS metadata entry and maintenance

A key responsibility of WIGOS observing system operators is to supply and maintain accurate WIGOS metadata in the OSCAR/Surface database. Typically, NMHSs are the authorized users of OSCAR/Surface (through their national focal points) and will undertake this responsibility for NMHS stations. Data entry and maintenance may be through the OSCAR/Surface web interface or through a machine-to-machine interface for NMHSs with existing metadata management systems.

In the case of non-NMHS observing sites, it is expected that the NMHS will take responsibility for maintenance of metadata in OSCAR/Surface on behalf of partners. The OSCAR/Surface national focal points will have the training and expertise to manage OSCAR/Surface metadata and are best positioned to ensure the accuracy and coherence of these metadata for national observing capabilities. At present, there are no defined standards for the accuracy of WIGOS metadata (a possible future development), so OSCAR/Surface national focal points are encouraged to work with partners to strive for the highest achievable accuracy to support the intended use of the observations. For instance, long-term climate monitoring requires greater accuracy and completeness of metadata than Numerical Weather Prediction. The regular

review and update of non-NMHS station metadata in OSCAR/Surface should be an integral part of agreements with partners.

7.7.4 Mechanisms for the exchange of observational data

Once station identifiers and metadata have been established, the actual transfer of observational data can occur. To support the principle of mutual benefit, the technical mechanisms for the exchange of observational data should be bidirectional, so that:

- NMHSs receive observations from partners;
- NMHSs provide access to observations. Ideally the observations made available by the NMHSs result from the consolidation of observations from many suppliers, which have been quality assessed, are presented in a consistent format, and are offered through interfaces based on standards.

In this context, the WMO Hydrological Observing System (WHOS) is intended to provide an additional capability as a federated resource for National Hydrological Services. This System is built around two fundamental components: service providers and service consumers. Although service consumers can directly connect with service providers to request and receive observational data and products, a third component, a service broker, is introduced to facilitate discovery and access across different service providers by offering mediation services. The WMO Hydrological Observing System provides advanced data access and analysis capability through web services that use standardized data formats and service types, together with common formats and services, with the aim of improving interoperability between clients and server interfaces.

The exchange of data involves two elements: (a) the exchange format, and (b) the data access mechanism.

7.7.4.1 Exchange format

The WMO Information System (WIS) defines standards for the discovery and operational exchange of data among WMO Members (for example, the WIS Discovery Metadata standard, Table Driven Code Forms). However, these standards are quite complex, unique to WMO, and are not widely used by non-NMHS organizations. Instead, there are many formal and de facto standards for data exchange with partner organizations that are commonly used because of their ease of use, practicality, and wide acceptance across numerous communities. Such standards range from the manually-initiated exchange of simple Comma-separated Values (CSV) files to fully automated, dynamic queries through geospatial web services.

Given the diversity of partners and technology environments, there is no firm guidance on specific standards or tools, and the choice of exchange format may depend on the telecommunications protocol being used. Ideally an exchange format should be:

- Open: based on open, non-proprietary, industry-wide standards;
- Portable: able to operate on any platform or operating system;
- Stable: with a large user base/community which will encourage long-term stability and availability;
- Self-describing: the format and content are fully described in the exchanged file.

Common formats used for the exchange of hydrometeorological data today include, but are not limited to:

- Web form – manual input of data on a website or smart phone app;

- CSV – Comma-separated Values;
- XML – for example, Open Geospatial Consortium (OGC) Observations and Measurements, WaterML2, or other derivatives of the OGC Geography Markup Language (GML);
- JSON – JavaScript Object Notation;
- NetCDF – Network Common Data Form;
- HDF – Hierarchical Data Format.

The use of open, non-proprietary exchange formats facilitates vendor-neutral and multi-application access whether off-the-shelf tools or custom solutions are used. For example, the open source [Geospatial Data Abstraction Library](#) (GDAL) provides read/write/translation capability for hundreds of formats for both raster (model output, satellite imagery) and vector (alerts, observations) data. The Geospatial Data Abstraction Library also provides support for numerous data access and visualization tools, both open source and commercial.

The use of open exchange formats with wide vendor and community support is encouraged as it reduces the barriers to hydrometeorological data and to new information communities.

7.7.4.2 Data access mechanisms

Regardless of the exchange format, the transfer of data requires an upload and/or download mechanism. The ubiquity of the Internet has provided a telecommunications backbone that lowers the barriers to data transfer, but there is still a range of access mechanisms of varying sophistication and complexity. The desirable characteristics of data exchange formats (open, portable, stable, etc.) are equally applicable to data access mechanisms.

Common data access mechanisms for meteorological data exchange include, but are not limited to:

(a) Human interface:

- (i) Data entry on a web form (desktop or phone app);
- (ii) File transfer by email attachment (manual transfer);
- (iii) File transfer via neutral data-sharing service (for example, iCloud, Dropbox);

(b) Machine-to-machine interface:

- (i) File transfer by email attachment (automated send);
- (ii) Automated download (data “pull” from Secure File Transfer Protocol (SFTP) or Web Accessible Folder (WAF) sites);
- (iii) Automated subscription service (event-driven “push” of data from the provider);
- (iv) Geospatial web services (dynamic, timely access through client/server environment and tools) based on international standards (OGC, ISO).

Like the choice of exchange formats, the choice of access mechanisms depends on the technical environments of the NMHS and its partner, and whether the access will be machine-to-machine or through human interaction. The choice should also be made bearing in mind the operational reliability and timeliness of the transfer, for instance, to meet global Numerical Weather Prediction (NWP) cut-off times of <2–3 hours. In general, automated transfer by email attachment is not recommended because of frequent issues with reliability (for example, emails not being sent, not received, blocked or misplaced by email filters).

Furthermore, the use of secure transmission protocols (for example, SFTP and Secure Shell (SSH)) is recommended to reduce security vulnerability (see section 7.7.8 on cyber security). These decisions need to be jointly made by the NMHS and its external supplier in order to enable and sustain a secure operational data transfer.

7.7.5 WIGOS Data Quality Monitoring System

The *Manual on the WIGOS*, section 2.4, specifies that Members shall ensure the quality control of WIGOS observations. This includes the application of real-time quality control prior to the exchange of observations via WIS, and non-real-time quality control prior to archiving. These requirements apply equally to observations from both NMHS and non-NMHS sources that are to be exchanged internationally, and they are also highly recommended for observations that are to be used only for national purposes.

Many NMHSs already have quality control procedures in place to support these requirements for their own observations, and it is recommended that the same procedures be applied to non-NMHS observations for consistency and to minimize the effort to maintain separate procedures and tools. Guidelines on quality control procedures for observations from automatic weather stations are provided in the *Guide to the Global Observing System* (WMO-No. 488), Appendix VI.2. Quality control considerations and procedures for climate observations are described in the *Guide to Climatological Practices* (WMO-No. 100), sections 2.6 and 3.4. [Quality Assessment Using METEO-Cert – The MeteoSwiss Classification Procedure for Automatic Weather Stations](#) (Instrument and Observing Methods Report No. 126) also provides useful guidance.

In addition to procedures applied by NMHSs, the WIGOS Data Quality Monitoring System (WDQMS) will assist Members in the evaluation of the quality of observations. The Quality Monitoring Function operated by global NWP or other Global Data Management Centres identify issues with data against predefined criteria. Regional WIGOS Centres can then use the WDQMS Evaluation Function and Incident Management Function to analyse these data issues and determine whether any of them should be regarded as an incident. The RWC can then engage with the NMHS or other authorized body to ensure that the incident is rectified in the most effective manner. Once an RWC is operational, the reports produced by the WDQMS on the performance of all observations will be issued to all relevant parties.

The WDQMS makes no distinction between NMHS and non-NMHS observations. Regional WIGOS Centres may have different procedures for NMHS- and non-NMHS- related incidents, and the incident management mechanisms may vary from one partner organization to another. It is strongly recommended that procedures for the management of data issues and incidents be included in an observational data agreement.

7.7.6 Technical management of constrained-use observations

As noted earlier, there may be constraints on the use and sharing of non-NMHS observations. The specifics of any constraints should be clearly defined in the agreement with the provider. It is very important that these conditions be respected in order to maintain the reputation of the NMHS as a trusted partner, and to ensure the willingness of external providers to contribute observations. Furthermore, a breach of the terms of an agreement may have legal consequences. Functionality within an NMHS data management system is therefore required to manage observations with constraints.

The WIGOS Metadata Standard specifies two parameters under Category 9: ownership and data policy, which can be used to detect observational data that require special consideration in processing (*WIGOS Metadata Standard* (WMO-No. 1192), Chapter 7).

Parameter 9–01 – Supervising organization: a mandatory parameter providing the name of the organization that owns the observation.

Parameter 9-02 – Data policy: a mandatory parameter that provides details relating to the use and limitations of the observation, imposed by the supervising organization. This parameter currently defines three observation policy conditions:

- WMO Essential – Resolution 40/25 observations with no constraints on use
[WMO_DataLicenceCode = 0]
- WMO Additional – Resolution 40/25 observations with constraints on use that need to be researched through other documentation
[WMO_DataLicenceCode = 1]
- WMO Other – Other observations with constraints not set by WMO policy
[WMO_DataLicenceCode = 2]

These parameters enable constrained observations to be detected in the NMHS processing systems, but these systems must also be able to interpret and use this information in accordance with the data policy of the provider. The three WMO_DataLicenceCodes may be insufficient to adequately cover all the observation policy variations across several partner organizations, so additional codes or internal tools may be required to add precision to the processing flow. For example, MeteoSwiss has implemented a hierarchical five-level framework that assigns an internal USE_LIMITATION_CODE to manage various levels of constraints (see Figure 7.2). The hierarchical approach has facilitated the technical implementation: a limited, but adequate, set of use cases is defined and constraints are applied progressively with the use of a single USE_LIMITATION_ID code.

Figure 7.2. The technical framework for the management of constrained data established by MeteoSwiss

7.7.7 Archiving

Observations from non-NMHS sources are often used to support near-real-time applications and services, but they may also offer opportunities to enhance the climate record.²⁴ The *Guide to Climatological Practices* (WMO-No. 100) outlines the basic principles and practices relevant for climate services, and includes guidance on climate observations, stations and networks (Chapter 2) and on climate data management (Chapter 3). Regarding non-NMHS observations, special attention should be paid to matters of data quality, longevity of the observation record and long-term preservation and access, as well as to matters of inter-comparability of observations. The WIGOS Metadata Standard is designed to capture information relevant to data quality and long-term inter-comparability, so attention to populating and maintaining the metadata records for both NMHS and non-NMHS climate observations is paramount.

The technical management of observational data for archiving purposes also requires special consideration. Observational data to support near-real-time applications are typically managed within an operational database, and specific arrangements are normally required to transfer these data (including metadata) to a separate climate data management system (CDMS) or to an International Data Centre. In archiving non-NMHS observations, it is important to be able to distinguish the different sources of data (through metadata fields or through separate databases) as there may be significant differences in the quality of data and metadata that could impact climate analyses and services. The subject of archiving externally-sourced data is covered in detail in the [Manual on the High-quality Global Data Management Framework for Climate](#) (WMO-No. 1238).

The above applies to data available in digital formats, but it is important to bear in mind that much historical data may exist only in hard copy (paper). Guidance on securing and archiving

²⁴ The climate record should be broadly interpreted in the context of this document as any form of meteorological, oceanographic, hydrological, cryospheric or other observation with a time-series component.

hard copy records and images is provided in [Guidelines on Best Practice for Climate Data Rescue](#) (WMO-No. 1182).

7.7.8 Cyber security

Cyber security is an area of concern due to growing threats to the integrity, reliability and privacy of information systems and data. The World Wide Web and, more recently, social networks have improved cooperation among WMO Members and have also facilitated the exchange of information with many new providers of observational data. Alongside these positive changes, however, an increasing number of cyber-security threats are present everywhere the Internet. Because of its widespread use, the Internet has unfortunately become a medium of choice for disseminating unwanted information and for launching electronic attacks against organizations and their information assets. It is, therefore, necessary for NMHSs to recognize these risks and to protect their information systems in order to maintain operational data processing and to securely exchange information.

As all WMO Members are interconnected, it is essential that each Member take appropriate measures to secure the exchange of its information and ensure that it will not be the cause of further security problems within WIS.

Security standards, recommendations and best practices have already been adopted by a large number of WMO Members for securing the exchange of information within WIS. The [Guide to Information Technology Security](#) (WMO-No. 1115) outlines the basic concepts and principles of information security, and provides a broad overview of the main information technology security components, processes and best practices. The principles described in the Guide can be used to exchange data with non-NMHS providers in order to ensure the consistency of security practices within the WMO community.

At the national level, cyber security requirements and implementation are increasingly being defined by organizational or national authorities and, in general, NMHSs are expected to comply with such requirements. The security requirements of non-NMHS organizations can vary widely and may sometimes be in conflict with those of NMHSs. Access to observational data across firewalls is a common challenge as organizations typically restrict external users' access to their systems. A frequently-used solution is to establish data repositories outside firewalls and to require the use of secure transmission protocols (for example, HTTPS, SFTP, SSH).

ANNEX. A MODEL FOR NON-NMHS OBSERVATIONAL DATA INGESTION

The present annex describes a generic model for the ingestion of observational data from non-NMHS organizations into NMHS data systems.²⁵ The model is schematically represented in Figure 7.3.

Figure 7.3. Non-NMHS observational data exchange model

PART ONE

Step 1: Decide the appropriateness of observational data for ingestion using a policy for selecting non-NMHS observational data based on five fundamental questions:

- (a) Value – What are the benefits and value for NMHS and non-NMHS suppliers of observational data?

²⁵ This model has been developed, implemented and applied by the Bureau of Meteorology (Australia).

The NMHS may assess value in three different areas: contribution to the network, quality of the data and relationship with the data supplier. For example:

- (i) How the observational data are going to be used and to provide value (impact on NMHS models, products and services);
- (ii) The extent of the NMHS reliance on the observations (can the observations be sourced elsewhere?);
- (iii) Required observational data quality;
- (iv) Influence of the prior relationship with the non-NMHS party;

Detailed questions about value may include:

- (i) Why do we want the information?
- (ii) What do we need to know to judge the value of the information?
- (iii) How do we know that the information is adding value (what is the key performance indicator)?
- (iv) Are the observational data filling a spatial or temporal gap in the current network or are they providing redundancy?
- (v) What is the quality of the observational data? (Will they satisfy the requirements of particular users? If not, is there sense in the collection, archiving and quality control of the observational data?)
- (vi) Is there a risk in having too much observational data?
- (vii) Can lower data quality be accepted in observation-sparse areas or where observational data are critical to a product?

The value proposition may also be considered by the supplier of observational data. For example, data suppliers recognize the key benefits of providing their observational data to an NMHS:

- (i) It promotes access of their data to a much wider audience;
- (ii) It enhances their own reputation by working in association with the NMHS;
- (iii) Much value is potentially added to the data through assimilation into NMHS products and services, particularly forecasting tools and models.

The final stage of the value assessment is to assign the observational data to a tier. This will help with decisions concerning many data requirements, the nature of an agreement and intellectual property rights.

A number of tools are needed at this stage of the decision-making process, including:

- (i) A policy for the value assessment;
- (ii) User requirements that articulate the frequency, reliability and spatial distribution of the data needed;
- (iii) A network design that reflects the user's spatial requirements for a particular type of observational data;

(iv) Quality standards and criteria for the observational data for each tier;

- (b) Metadata – Does the NMHS know enough about the observational data to make effective use of them?

The supply and maintenance of metadata is crucial to the ongoing assessment of observation quality by the NMHS. Consideration should be given to how often metadata need to be updated by the supplier.

Metadata should be obtained for each tier, and the risk associated with lack of metadata should be assessed. Appropriate storage, access and reporting of metadata and a mechanism for external agencies to submit and update metadata records should be in place.

- (c) Restrictions – Can the NMHS use the observational data as it pleases? For example, are there any terms of use? Are there any restrictions to intellectual property?

Some providers of observational data may place restrictions on redistribution or may demand that data be only for NMHS internal use. These observational data can support NMHS national products, but ideally NMHSs should encourage arrangements that are consistent with open data principles and that permit broad sharing and reuse. Key issues include:

- (i) Standard Open Data Licence or other open source agreement;
- (ii) Understanding of the NMHS readiness to accept risk;
- (iii) A priority rating on the value of the observational data.

- (d) Implementation – Can the NMHS access and manage the observational data and metadata?

Once the value and usefulness of the observational data has been determined, the next question is their accessibility and the capacity of the NMHS to assimilate the observational data into its system and use them.

For example:

- (i) Can the data be displayed?
- (ii) Are there any restrictions?
- (iii) Can the data be delivered securely?
- (iv) Can the data be archived and can quality control of the data be implemented?

Key information required may include:

- (i) The format, volume and content of the observational data;
- (ii) Transmission security;
- (iii) Estimates of communications costs;
- (iv) Estimates of integration costs.

- (e) Agreement – Do the NMHS and its partner have the ability to manage the relationship in the long term?

An agreement provides a consistent framework for:

- (i) Managing and monitoring the relationship;
- (ii) An ongoing assurance of the required observational data quality (through maintenance of metadata);
- (iii) The longevity of the data supply arrangement.

It is important that both parties understand their mutual commitments and impact. Most importantly, the agreement should include points of review and renewal to ensure regular contact between the organization and the supplier and a healthy working relationship.

Step 2: Assess and approve non-NMHS observational data for ingestion ensuring that:

- (a) The requestor (for example, an NMHS data user) assesses the appropriateness of the non-NMHS observational data using the above guidance;
- (b) The NMHS evaluates the request for approval. This may involve a cost-benefit analysis and a risk assessment.

The assessment may consider the following aspects:

- (i) Reliability of the source of observational data (particularly for operational use);
- (ii) Terms of use;
- (iii) Metadata availability;
- (iv) Compliance or compatibility with NMHS systems;
- (v) Regimes for site inspections, validation and maintenance;
- (vi) Data life cycle;
- (vii) Cost of using observational data and of maintaining an ongoing relationship;
- (viii) Observational data access and archiving;
- (ix) Willingness to enter into formal agreements.

PART TWO

Step 3: Develop an observational data supply agreement allowing the NMHS to mitigate identified risks and to ensure the continued supply of data as negotiated.

PART THREE

Step 4: Commence the technical ingestion and processing of non-NMHS observational data using standard and approved methods for formatting and transporting data (in line with NMHS policies and processes).

Step 5: Manage the arrangement for the supply of observational data, including ongoing monitoring of observational data quality, alerts, metadata updates, archiving (and retention) of observational data and applications by the NMHS (informed by the use of classification schemes such as network tiering or flags).

8. ESTABLISHING AND OPERATING A REGIONAL WIGOS CENTRE

8.1 INTRODUCTION

The present chapter provides guidance on the establishment and operation of a Regional WIGOS Centre (RWC). The overall purpose of RWCs is to provide Members and Regions with support and assistance in national and regional WIGOS implementation and related operational activities.

8.2 BACKGROUND AND RATIONALE

The Executive Council at its sixty-eighth session (EC-68, 2016) recognized the critical role that RWCs would play in advancing the implementation of WIGOS at the regional level by providing regional coordination, technical guidance, assistance and advice to Members and regional associations in accordance with the *Technical Regulations* (WMO-No. 49), Volume I, and the *Manual on the WIGOS*.

The World Meteorological Congress agreed at its nineteenth session (Cg-19), through Resolution 37, that the operational deployment of RWCs is one of the six main priorities of WIGOS in 2020–2023 (*World Meteorological Congress: Abridged Final Report of the Nineteenth Session* (WMO-No. 1326)). The details are provided in the Plan for the WMO Integrated Global Observing System Initial Operational Phase (2020–2023) adopted by the Executive Council at its seventy-third session (EC-73), through Resolution 9 ([Executive Council: Abridged Final Report of the Seventy-third Session](#) (WMO-No. 1277)).

WMO Regions differ in terms of WIGOS readiness, economic strength, and cultural and linguistic characteristics; these differences need to be taken into account in establishing and operating their respective RWCs.

The EC-68, through Decision 30, endorsed the Concept Note on Establishment of Regional WIGOS Centres, as general guidance for regional associations ([Executive Council – Sixty-eighth Session: Abridged Final Report with Resolutions and Decisions](#) (WMO-No. 1168)). The basic principles for the establishment and operation of RWCs and the specifications of mandatory and optional functions are provided in 8.3.

8.3 REGIONAL WIGOS CENTRES: ESSENTIALS

8.3.1 Purpose and objectives

Under the governance and guidance of the management group of the respective regional association, and with the support of relevant regional working bodies, the overall purpose of the RWCs is to provide support and assistance to WMO Members and Regions for their national and regional WIGOS implementation efforts.

The specific objectives of a RWC depend on its implementation stage, which are described in 8.8 of the present chapter.

8.3.2 Terms of reference

8.3.2.1 Functionalities

Basic functions of the RWC should be regional coordination, guidance, oversight and support for WIGOS implementation and operational activities at the regional and national levels, as daily activities. The following mandatory and optional functions are specified [below](#). For

detailed guidance of the mandatory functions see *Technical Guidelines for Regional WIGOS Centres on the WIGOS Data Quality Monitoring System* (WMO-No. 1224).

8.3.2.1.1 Mandatory functions

- (a) (Regional) WIGOS metadata management (working with data providers to facilitate collecting, updating and improving the quality of WIGOS metadata in [OSCAR/Surface](#));
- (b) (Regional) WIGOS performance monitoring, evaluation and incident management (WIGOS Data Quality Monitoring System – WDQMS) and follow-up with data providers in case of data availability or data quality issues.

Chapters 3 and 9 of the present Guide provide more details on OSCAR/Surface and WDQMS, respectively.

8.3.2.1.2 Optional functions

Depending on available resources and regional needs, one or more optional functions may be adopted, such as: (a) assistance with the coordination of regional/subregional and national WIGOS projects; (b) assistance with regional and national observing network management; and (c) support for regional capacity development activities.

8.3.2.2 Incident management

RWCs should run the incident management function using the Incident Management System (IMS) provided by WMO, a webtool accessible online. Registered users, including the RWCs, WDQMS NFPs and WIGOS Quality Monitoring Centres can create incident tickets in IMS.

RWCs should utilize the results of quality evaluation and incident management practices to identify systemic issues that might need to be addressed to improve the performance of stations through proposed modification or changes to processes and procedures.

Results of quality evaluation analyses and resulting changes to the observing system should be notified, recorded and documented in line with national, regional and WMO quality management standards and recommended procedures.

Member engagement in the incident management process, through close collaboration with the RWCs regarding their functions, is essential for allowing improvement to station performance.

8.3.2.3 Links to other WMO entities

The RWCs should work closely both with the WMO Secretariat (including Regional Offices) and with their respective regional working bodies to ensure efficient and effective implementation and operation of WIGOS. The RWCs should liaise with relevant existing WMO centres, in particular with the Regional Telecommunication Hubs/Global Information System Centres (RTHs/GISCs), Regional Instrument Centres (RICs), Regional Training Centres (RTCs) and Regional Climate Centres (RCCs) regarding all WIGOS-related activities in the WMO Region.

8.4 IMPLEMENTATION OPTIONS AND RESOURCING

8.4.1 Implementation options

In principle, each Member of any given WMO Region should be covered by an RWC. RWCs may be implemented either centrally, at an overall regional level where a Member or consortium of Members provide support for the entire Region, or at a subregional level, that is, aligned with the natural geographic or linguistic boundaries existing within the Region.

RWCs may be implemented either as monolithic entities (single multifunctional RWC), with a single Member taking on the responsibility for the entire set of required functionalities, or as virtual/distributed centres (an RWC network), in which a consortium of Members share these responsibilities between themselves, possibly under the overall coordination of a lead organization.

8.4.2 Resourcing requirements

The responsibility for resourcing the establishment and operations of an RWC rests with the Member(s) hosting the RWC, which should secure suitable infrastructure, technical, human and other resources for establishment and sustained operations of the centre. The amount and nature of resources required will depend on the intended functionalities of the centre, the number of affiliated Members and the dimension of their respective observing networks.

8.4.2.1 Basic infrastructure

In order to ensure a rapid start-up for an RWC, it would be desirable for the host country to make available to the centre, either permanently or on a temporary basis, adequate, secure, fully-equipped and easily accessible premises. These premises must be supplied with water and electricity and must be equipped with a reliable telecommunications system.

8.4.2.2 Technical infrastructure

RWCs must have adequate information technology facilities and infrastructure (workstations, high-speed Internet access, and data processing and storage capabilities) needed for RWC mandatory functions.

RWCs should have access to information, data and tools that support quality evaluation processes. As a minimum, these include:

1. ___ Observation bulletins in TAC and BUFR received via WIS/GTS and stored in an operational observation database;
2. ___ OSCAR/Surface, WDQMS Webtool and IMS;
3. ___ Additional quality monitoring reports and statistics provided by other global, regional or national monitoring systems in a form that allows flexible and rapid use for the quality evaluation process, including rendering of the data for analysis, comparison, plotting, etc.;
4. ___ Data analysis applications and tools.

8.4.3 Human resources

The necessary human resources (managers and scientific, technical and administrative personnel) should be specified in terms of competencies and number of staff (expressed in full-time equivalents) to be allocated to RWC establishment and operations. The staff may be permanent employees from National meteorological and Hydrological Services or may be hired on a temporary basis. Where appropriate, some of the responsibilities of an RWC may be fulfilled through secondment of staff from other WMO Members in the WMO Region.

RWC staff should have the following competencies:

1. ___ Detailed understanding of the surface-based system of GOS and GBON (to be expanded in future to other WIGOS observing components, although the functions might be split among multiple RWCs);
2. ___ Sound knowledge of meteorological observations, station metadata and WMO codes, as well as skills in data analysis;

3. ... Skills and knowledge in quality management systems (in general), and incident management processes (in particular);

4. ... Skills and knowledge in communication and report writing.

Additional competencies may be required when RWC's scope expands.

8.4.4 Financial resources

The responsibility for funding RWC operations rests with the Member(s) involved. It might be difficult for less well-resourced Members to identify the resources required at the national level for operating an RWC. In such cases, the RWC will have to identify partners and develop effective resource mobilization strategies with a view to deriving maximum benefit from various multilateral funding mechanisms and regional development institutions. The WMO Secretariat is prepared to support all stages of such resource mobilization efforts.

8.5 RISK ASSESSMENT AND MANAGEMENT

The main risks, their impact on RWC operations and WIGOS as a whole, and possible mitigation measures should be considered when establishing an RWC. The level of risk should be assessed (low, medium, high) for each type of risk. Typical risks are:

- (a) Political/institutional, such as low political commitment to the RWC, waning interest from stakeholders, or change in government;
- (b) Financial, such as inadequacy of the financial management system, or lack of resources;
- (c) Human resources-related, such as a lack of skills and/or expertise, or a mismatch between existing and required experience and specialized skills.

A risk management plan should be developed for each implementation activity, including risk mitigation.

8.6 GOVERNANCE, MANAGEMENT AND PLANNING

The RWC management (that is, the RWC Manager and RWC Executive) should plan and work closely with the president of the regional association, the management group and the relevant WIGOS working body of the regional association, the WMO Secretariat and other WMO-related entities.

8.7 MONITORING AND EVALUATION

The RWC Manager is responsible for routine management, coordination, monitoring and evaluation of the RWC operations, and for reporting to the Executive Management of the organization under which the RWC is framed.

The Manager is also responsible for updating procedures and practices if and when needed. The monitoring and evaluation process should demonstrate the progress achieved as well as identify risks, problems and difficulties encountered, and the need for adjustment to the RWC operations accordingly.

8.8 IMPLEMENTATION STAGES

The three stages for implementing an RWC are described in the present section, along with their corresponding objectives. The three stages are expected to be sequential, starting with the start-up phase (launch period), leading to a pilot phase/mode and then followed by an operational phase/mode.

8.8.1 Start-up phase

The objectives of this phase are to:

- Define an RWC concept of operations and its framework within the region/subregion;
- Formalize the intention of a Member/group of Members to host and operate an RWC.

The candidate Member(s) for establishing an RWC should follow steps 2 and 3 of the process for the designation, assessment and reconfirmation of Regional WMO Integrated Global Observing System Centres (Annex 1 to the present chapter).

The application template to be used by a candidate RWC is reproduced in Annex 2 to the present chapter. The application must include the Terms of Reference, covering the main WIGOS functionalities offered by the Centre, including, at a minimum, the mandatory functions as specified under 8.3.2.1.1, taking into account the type of proposed centre (see implementation options in 8.4.1). Depending on available resources and the willingness of the candidate Member(s), one or more optional functions may be included, for example, assistance with regional and national observing network management, calibration support, education and training.

During the start-up phase, which may last several months, the framework for the pilot phase operations is created, the infrastructure and human resources are made available, the functionalities assigned to the centre are specified and clarified, partners are mobilized and consortia of technical, scientific and financial partners, if needed, are set up.

WMO should, wherever possible, encourage the existing WMO regional centres to carry out the RWC activities, thus ensuring optimization of technical and human resources. Already existing structures and mechanisms should be considered when implementing WIGOS at the regional and national levels, including their potential roles in RWCs. Every effort should be made to avoid any duplication with responsibilities and functionalities of already existing WMO regional centres. Instead, possible synergies with such centres should be exploited.

Existing geographic, cultural and linguistic differences within each WMO Region should be taken into account in determining the appropriate establishment and models of operation of RWCs. Therefore, each respective regional association should decide upon its own mechanism for establishing its RWCs with clearly specified Terms of Reference in line with guidance from INFCOM, reflecting its needs, priorities, existing capabilities and facilities. The relevant WIGOS working body in the Region should be involved in the process of establishing the RWC and have general oversight once it has become operational.

8.8.2 Pilot phase

The objectives of this phase are: (a) to help a group of Members within the domain of the RWC to benefit from WIGOS; and (b) to lay solid foundations for a transition to a subsequent operational phase, depending on final assessment. The functionality and services provided during this phase are evaluated on a regular basis by the RWC Manager(s), with methods readjusted as necessary, and with support from the WMO Secretariat.

Expected results of setting up an RWC in pilot phase include an assessment of the feasibility of subsequently establishing a fully operational RWC and, based on the final assessment, a set of recommendations on key aspects of such a centre, including institutional set-up, concept of

operations and strategy for long-term sustainability. Therefore, the pilot phase should include the development of a long-term funding strategy based on effective resource mobilization where appropriate.

The pilot phase begins following successful results from steps 4 and 5 of the process for the designation, assessment and reconfirmation of Regional WMO Integrated Global Observing System Centres (Annex 1 to the present chapter). At the beginning of the pilot phase, the RWC Manager(s) will ensure that the required preparatory work is conducted, and that implementation arrangements are put in place in accordance with the RWC application.

At the end of the pilot phase, according to step 6 of the process for the designation, assessment and reconfirmation of Regional WMO Integrated Global Observing System Centres (Annex 1 to the present chapter), the RWC Manager will prepare and submit a Progress Report to the president of the regional association, the relevant regional WIGOS working body, the management group of the regional association and the WMO Secretariat. In accordance with the template provided in Annex 3 to the present chapter, the report will contain an evaluation of the RWC performance and sustainability of its results, and will document the experience and lessons learnt during the pilot phase.

8.8.3 Operational phase

The objective of an RWC during this phase is to contribute to improving the observational metadata and data that are internationally exchanged from observing stations in the concerned region/subregion, in regard to:

- (a) metadata availability, quality and completeness (in OSCAR/Surface);
- (b) data availability, in terms of reporting frequency and regularity; data quality, in terms of accuracy and completeness; and timeliness of data reporting.

The operational phase begins with the designation of the RWC as being in the operational phase, following successful audit results in steps 6 and 7 of the process for the designation, assessment and reconfirmation of Regional WMO Integrated Global Observing System Centres (Annex 1 to the present chapter).

During the operational phase, the RWC is annually assessed in accordance with step 8 of the process for the designation, assessment and reconfirmation of Regional WMO Integrated Global Observing System Centres (Annex 1 to the present chapter). The reconfirmation of designation of the RWC in the operational phase is based on the results of assessments as referred to in step 9 of the same process.

ANNEX 1. PROCESS FOR THE DESIGNATION, ASSESSMENT AND RECONFIRMATION OF REGIONAL WMO INTEGRATED GLOBAL OBSERVING SYSTEM CENTRES

1. INTRODUCTION

The process described in the present Annex is intended to support the regular audit of Regional WMO Integrated Global Observing System Centres (RWCs, or Regional WIGOS Centres)) to ensure they are delivering according to their Terms of Reference (ToR) and functioning as required by the Regional Association and in line with WMO standards and guidelines.

The overall purpose of the RWCs is to provide support and assistance to WMO Members and the Regional Associations (RAs) for their national and regional WIGOS implementation efforts, as part of the WIGOS initial operational phase.

RAs should do their utmost to establish one or more RWCs within their area of responsibility and ensure unique assignment of each Member of the WMO Region to a relevant RWC.

An RWC can be hosted by one Member and cover all required functions,²⁶ or it can be a virtual/distributed RWC where several Members host different “nodes” for different functions, with all those nodes comprising one RWC. For effectiveness, and to avoid confusion, RAs should ensure that there is no overlap of the activities and responsibilities of different RWCs, or their individual nodes. Each RWC, including its nodes, will undergo a pilot phase prior to approval as an operational RWC.

Technical evaluation of RWC applications and assessment of RWCs²⁷ will be done by the Commission for Observation, Infrastructure and Information Systems (INFCOM), while the designation/reconfirmation will be a decision taken by the relevant RA.

2. PREPARATORY REQUIREMENTS

A candidate RWC should be capable of carrying out mandatory RWC functions as defined in the RWC ToR, before an application is submitted.

3. APPLICATION

The candidate RWC will express its intention to be designated as an RWC in pilot mode by sending an application²⁸ to the president of the relevant RA with a copy to the president of INFCOM and to the Secretary-General of WMO. Should any required information be missing from the application, the WMO Secretariat will communicate the shortcoming(s) to the candidate RWC, which must ensure that the missing information is provided before assessment of the application proceeds.

4. EVALUATION OF APPLICATIONS

When a submitted application is complete, the WMO Secretariat, in consultation with the president of INFCOM and the president of the relevant RA, will make arrangements for its evaluation by a team of experts. Membership of the team (hereinafter called the evaluation team) will be approved by the president of INFCOM, in consultation with the president of the RA.

The results of the evaluation process²⁹, together with a recommendation for acceptance/rejection of the application, will be submitted to the president of INFCOM for endorsement on behalf of INFCOM, and will then be conveyed to the Secretary-General of WMO. The Secretary-General will inform the president of the RA and the Permanent Representative (PR) of the Member with WMO of the INFCOM recommendation.

²⁶ See the Guide to the WMO Integrated Global Observing System (WMO-No. 1165), Chapter 8.

²⁷ In case of a virtual/distributed RWC, the process described here applies to the whole RWC, although each node should be evaluated individually, meaning that the outcomes of the evaluation may contain conclusions and recommendations on the performance of the individual nodes or of the whole RWC, or both.

²⁸ The application template for a candidate RWC is available in the Guide to the WMO Integrated Global Observing System (WMO-No. 1165), Chapter 8, Annex 2.

²⁹ The anticipated duration of the evaluation process is three months.

5. DESIGNATION OF A REGIONAL WIGOS CENTRE IN PILOT MODE

Upon successful evaluation of the application and positive recommendation of INFCOM, the relevant RA will be invited to designate the new RWC in pilot mode.

Prior to the designation, the RA and RWC will agree on an initial start date of the pilot phase, which will be communicated to all stakeholders.³⁰

6. EVALUATION OF A REGIONAL WIGOS CENTRE IN PILOT MODE

Evaluation of an RWC in pilot mode will be performed only after the RWC has been operating in pilot mode continuously for a minimum of one year, and has provided regular monthly quality performance reports³¹ and the final progress report of RWC activities to the president of the RA and the WMO Secretariat.

Initiation of the evaluation of an RWC in pilot mode will be communicated by the WMO Secretariat to the PR(s) of Member(s) hosting the RWC in pilot mode, with a copy to the president of the RA and the president of INFCOM.

The RWC in pilot mode will submit a progress report³² (each node will submit a separate progress report, in the case of a virtual/distributed RWC) to the WMO Secretariat within one month after the initiation of the evaluation process. The WMO Secretariat will ensure that the report is complete and complemented by any additional relevant information³³ needed for the evaluation.

The WMO Secretariat, in consultation with the president of INFCOM, will make arrangements for the evaluation by the evaluation team.

The work of the evaluation team will be done in consultation with relevant regional working bodies and, in principle, remotely. However, if necessary, on-site visits by the evaluation team might be arranged.

The results of the evaluation process, together with a recommendation,³⁴ will be submitted to the president of INFCOM for endorsement on behalf of INFCOM and will then be conveyed to the Secretary-General of WMO.

The Secretary-General will inform the president of the RA and the PR of the Member with WMO of the INFCOM recommendation.

³⁰ Whenever possible and adequate, the WMO Secretariat will consult with the relevant Member(s) regarding the actual start of operations, including requests to nominate (or update/review) their NFPs on WIGOS Data Quality Monitoring System (WDQMS), who will be responsible for interaction with the RWC.

³¹ The monthly reports should be developed in accordance with the template provided by the WMO Secretariat.

³² The progress report must be developed in accordance with the template provided by the WMO Secretariat.

³³ This may include, for example, the relevant statistics produced by the global WDQMS Incident Management System (IMS), other relevant reports from the RWC, as well as other supportive material, as appropriate, including any reports or recommendations from relevant regional working groups/teams.

³⁴ The recommendation(s) can be applicable to individual nodes and/or the RWC as a whole. A recommendation(s) should include, among others, a proposal for either designation or non-designation. In the event that INFCOM finds that an RWC, or its individual node(s), does not meet the necessary requirements for designation, the RA might decide not to proceed with the designation. Instead, the RA might encourage the RWC to improve its performance and might propose re-evaluation once the INFCOM proposals for improvement have been met.

7. DESIGNATION OF A REGIONAL WIGOS CENTRE IN OPERATIONAL MODE

Upon positive results and recommendation by INFCOM, the relevant RA will formally designate the RWC in operational mode. In the case of a virtual/distributed RWC, and based on INFCOM's recommendation, the RA may decide to designate only certain individual node(s) as part of an operational RWC.

8. ASSESSMENT

According to its ToR, an RWC reports on its activities annually by submitting a progress report (one progress report for each node, in the case of a virtual/distributed RWC) to the WMO Secretariat. The WMO Secretariat will publish the RWC reports on the WIGOS website.

The WMO Secretariat, in consultation with the president of INFCOM, will make arrangements for the regular evaluation of the progress reports by the evaluation team, to assess the compliance of an RWC with its ToR.

The results of each evaluation will be provided to the president of INFCOM, the president of the relevant RA and relevant PR. If necessary, an evaluation team might have to verify RWC capabilities and performances by making on-site visits.

If an RWC fails to report on its activities for at least two consecutive years, or if the evaluation results indicate lack of compliance with the RWC's ToR, the WMO Secretariat will inform the president of INFCOM and the president of the RA that the RWC status should be reassessed.

9. RECONFIRMATION OF A REGIONAL WIGOS CENTRE

Prior to each regular Congress, the WMO Secretariat will invite the president of each RA to reconfirm the arrangements with its regional Members for hosting RWCs.

Based on the outcomes of the assessment of an RWC and the written reconfirmation from the PR of the Member hosting the RWC, each RA will be invited to reconfirm its RWC(s), or to take appropriate measures in the event that an RWC has not provided satisfactory services in compliance with its ToR.

ANNEX 2. APPLICATION TEMPLATE FOR A CANDIDATE REGIONAL WIGOS CENTRE

An agency or organization that wishes to be considered for WMO designation as a Regional WIGOS Centre (RWC) will submit its application, in accordance with the [Guide to the WMO Integrated Global Observing System](#) (WMO-No. 1165), 8.8, in writing through, and with the endorsement of, the Permanent Representative of the Member in which the candidate RWC is situated.

The application should comprise a letter of intent that clearly states the candidate's willingness and ability to provide RWC functionalities, and an annex containing the following information (this applies also to individual nodes within a virtual/distributed RWC which will collectively fulfil the RWC functions):

1. Name of the Member, WMO regional association, name of the organization and full address;
2. Affiliation (sponsors, stakeholders, partnering agencies, etc.) at the global, regional and national levels;

3. Mandate of the Centre relevant to WIGOS activities (mandatory and optional functions);
4. Liaison with relevant existing WMO centres, particularly regional centres;
5. URLs for pages on the Centre's website where WIGOS-related activities are described;
6. Current operational activities relevant to the candidate's application (following the mandatory and optional RWC functions);
7. Staff deployment/human resources relevant to RWC activities (managerial, scientific, technical and administrative categories);
8. Description of current facilities, the necessary basic physical infrastructure and communication systems relevant to RWC mandatory and optional functions;
9. Funding strategy to ensure the long-term sustainability of the RWC;
10. Geographical/economic/linguistic region for which the RWC functionalities are offered;
11. Type of RWC (a single multifunctional RWC or a virtual/distributed RWC (RWC network) provided by a group/consortium of Members);
12. Proposed RWC Manager (name, position, contacts and curriculum vitae);
13. Stakeholders engaged in the current and planned RWC operations;
14. Relevant national focal point(s);
15. RWC proposal:
 - Prepared by (name, position);
 - Approved by (name, position);
 - RWC Executive (name, position);
 - RWC Terms of Reference;
 - Implementation period;
 - RWC budget;
 - Funding sources;
 - List of activities, deliverables, outcomes, milestones, resources required and associated risks;
 - Additional documentation demonstrating the experience and the capacity of the candidate organization to fulfil the described functions;
16. Additional information as appropriate.

References:

- World Meteorological Organization (WMO). *World Meteorological Congress: Abridged Final Report of the Eighteenth Session* (WMO-No. 1236). Geneva, 2019.
- World Meteorological Organization (WMO). *Executive Council: Abridged Final Report of the Seventy-third Session* (WMO-No. 1277). Geneva, 2021.
- World Meteorological Organization (WMO). *Executive Council, Sixty-eighth Session: Abridged Final Report with Resolutions and Decisions* (WMO-No. 1168). Geneva, 2016.

World Meteorological Organization (WMO). *Project Management Guidelines and Handbook*, Parts I and II. Geneva, 2016.

ANNEX 3. TEMPLATE FOR REGIONAL WIGOS CENTRE PROGRESS REPORT

A Member hosting an RWC or a node, that has been recognized by the Regional Association, should use this template to report to the Regional Association on the progress made. The progress report should be prepared by RWCs in accordance with the "Process for the designation, assessment and reconfirmation of Regional WMO Integrated Global Observing System Centres" (Annex 1 to chapter 8 of the *Guide to the WMO Integrated Global Observing System* (WMO-No. 1165)).

The following topics, that are aligned with the application template, should be covered in such a progress report:

1.	Regional Association	The relevant WMO Regional Association
2.	Member	Name of the WMO Member reporting
3.	Organization and full address	Name of the organization reporting and its full address, including the position of the RWC within the national/NMHS organization
4.	Period covered by this report	Time period (month and year) covered by this report
5.	Type of RWC (single multifunctional RWC or as virtual/distributed RWC (network) provided by group of Members)	Type of RWC and other RWCs involved if the functions are distributed
6.	Members covered by the RWC	List of Members covered by the RWC
7.	Engagement with affiliated Members	Description of how and how often the RWC coordinates and discusses activities with affiliated Members
8.	Mandate of the Centre relevant to WIGOS activities – Mandatory functions	List of mandatory functions performed by the RWC (only applicable for RWC-nodes as part of a virtual/distributed RWC network)
9.	Mandate of the Centre relevant to WIGOS activities – Optional functions	List of optional functions performed by the RWC
10.	Software used for the RWC activities in addition to WIGOS tools	Brief description of any software used in performing RWC functions (in addition to WIGOS tools – <i>OSCAR/Surface</i> , <i>WDQMS</i> webtool and <i>IMS</i> for RWC)
11.	Website of RWC	URL of any website(s) dedicated to the RWC activities
12.	Operational activities related to the mandatory functions	Description of the activities developed in relation to the mandatory function(s) in the reporting period. In particular, the following items: - Number of issues per country identified and followed up - Number of issues per country resolved - Any long-term open and unresolved issues
13.	Operational activities related to the optional functions	Description of the activities developed in relation to the optional function(s), for example training provided by RWC to Members
14.	Other activities relevant to the WIGOS implementation at national and regional levels	Description of other relevant activities developed by the RWC, such as assistance and support in developing National and Regional WIGOS Implementation Plans, or others
15.	Liaison with relevant existing WMO Centres, particularly regional centres	Description of the activities developed in liaison with other WMO Centres, such as Regional Training Centres (RTC), Regional Instrument Centres (RIC), WMO Information System (WIS) Centres, etc.
16.	Staff involved in the daily operations relevant to mandatory functions	Number and competencies of staff involved in the daily operations, including any relevant trainings they have recently attended
17.	Description of current facilities, the necessary basic physical infrastructure,	List of relevant facilities/infrastructures being used for the RWC activities, such as, workstations, databases, Internet or other communication systems, etc.

	and communication systems relevant to RWC mandatory and optional functions	
18.	Funding strategy to ensure the long-term sustainability of the RWC	Short description of the funding strategy that has been adopted for the RWC, including for capacity development activities
19.	Languages offered when interacting with the Members of the WMO Region	Languages offered by the RWC when interacting with the affiliated Members
20.	Lessons learnt and future plans to improve the RWC	Description of any relevant lessons learnt and plans to improve the capabilities and performance of the RWC in the near future
21.	Comments	Any additional comments, complementary information and/or suggestions

9. WIGOS DATA QUALITY MONITORING SYSTEM FOR SURFACE-BASED OBSERVATIONS

Regulations related to the WIGOS Data Quality Monitoring System (WDQMS) are provided in the *Manual on the WIGOS*.

[The Technical Guidelines for Regional WIGOS Centres on the WIGOS Data Quality Monitoring System](#) (WMO No. 1224) [provide details for](#) Regional WIGOS Centres (RWCs) [and the WDQMS national focal points to](#) successfully run the WDQMS.

WIGOS Data Quality Monitoring System webtool

The WDQMS webtool is a resource to monitor the performance of the WIGOS observing components. The system is developed by WMO, under the guidance of INFCOM, and is hosted by the European Centre for Medium-range Weather Forecasts (ECMWF) in accordance with a Memorandum of Understanding between ECMWF and the WMO Secretariat. The webtool displays information provided by contributing Numerical Weather Prediction (NWP) centres, called WIGOS Quality Monitoring Centres (WQMC).

The WQMCs are:

- The European Centre for Medium-range Weather Forecasts (ECMWF);
- Deutscher Wetterdienst (DWD) (the German weather service);
- The Japan Meteorological Agency (JMA); and
- The United States National Centres for Environmental Prediction (NCEP).

The WDQMS webtool monitors in near real time the observations from the Global Observing System (GOS) land-based surface and upper-air stations as well as the observations from both the Global Climate Observing System (GCOS) Surface Network (GSN) and the GCOS Upper-Air Network (GUAN). The NWP module of the webtool monitors the performance of all surface and upper-air (radiosonde) land stations documented in [OSCAR/Surface](#), based on near-real-time monitoring information provided by the WQMCs.

The WDQMS collects 6-hourly quality monitoring (QM) reports (CSV files in a commonly agreed format containing information for each observing station based on data assimilation results) from these four WQMCs and stores the data in the WDQMS database at ECMWF. The figure in this section shows a diagram of the QM data flow for the NWP module of the WDQMS webtool, where the database fed by the NWP QM reports and the web-based application constitute the back and front end of the QM system, respectively. The [online user guide](#) provides more information about the WDQMS webtool.

Figure 9.1 Diagram of high-level WDQMS webtool architecture

The evolution of the WDQMS takes place under the guidance of [INFCOM](#). Any NWP centre willing to contribute to WDQMS can become a WQMC. The [Technical Specifications for WIGOS Quality Monitoring Centres](#) (WIGOS Technical Report No. 2022-1), maintained by INFCOM, specifies the file exchange format and other aspects of operational coordination.

10. GUIDANCE ON THE IMPLEMENTATION OF ATTRIBUTES SPECIFIC TO WIGOS COMPONENT OBSERVING SYSTEMS

10.1 GLOBAL CRYOSPHERE WATCH

10.1.1 Guidance on the definition of the Global Cryosphere Watch stations

The *Manual on the WIGOS*, section 8, defines the attributes specific to the observing component of the Global Cryosphere Watch (GCW).

The GCW surface observing network is comprised of a core component called CryoNet, CryoNet contributing stations, and GCW affiliated stations, generically known as GCW stations. Any GCW station measures one or more components of the cryosphere and one or more variables of each component, for example depth and density of the component snow (see [section 10.1.3](#) below). The GCW network builds on existing cryosphere observing programmes and promotes the addition of standardized cryospheric observations to existing facilities to meet specific observational requirements defined in the *Manual on the WIGOS*.

GCW covers all components of the cryosphere (solid precipitation, snow, glaciers, ice caps, ice sheets, ice shelves, icebergs, sea ice, lake ice, river ice, permafrost, and seasonally frozen ground).

Meteorological observations of air temperature, air humidity, wind speed and wind direction are mandatory observations for CryoNet stations, while they are optional for CryoNet contributing stations.

The observing and measurement practices to be applied at GCW stations, and primarily at CryoNet stations, are those documented in the *Guide to Instruments and Methods of Observation* (WMO-No. 8), in particular Volume II: Measurement of Cryospheric Variables.

A CryoNet station is either Primary or Reference:

- Primary – Has a target (intent) of long-term operation and at least a 4-year initial commitment;
- Reference – Has a long-term operational commitment and long-term (more than 10 years) data records.

A CryoNet station may have one or more additional attributes:

- Cal/val – The station is used for calibration and/or validation of satellite products and/or (Earth system) models, or it has been used for such purposes in the past and still provides the needed facilities;
- Research – In addition, the station has a broader research focus related to the cryosphere.

The CryoNet contributing stations provide useful measurements of the cryosphere, but their data records may be shorter or contain large gaps, for example, stations which are no longer operational or which do not completely follow CryoNet measurement practices. A CryoNet

contributing station is required to measure at least one variable of at least one cryospheric component (such as snow, permafrost, sea ice, and the like) from among those indicated in section 10.1.3. Mobile platforms such as ships, drifting stations and buoys may also be CryoNet contributing stations. CryoNet contributing stations may have the attribute "Reference", that is, have a long-term operational commitment and/or long-term (more than 10 years) data records.

All GCW stations are registered in the WMO [OSCAR/Surface](#) database and make available their data and metadata. OSCAR/Surface allows them to track changes in instrumentation, traceability, and observation procedures and practices. Their data is made available according to an agreed protocol, in a timely manner, to a data centre which is interoperable with the GCW Data Portal.

A CryoNet cluster is a grouping of stations, generally encompassing an area greater than a conventional observing station and is defined in the *Manual on the WIGOS*, section VIII. A CryoNet cluster is comprised of two or more active stations with observing capabilities that are contributing together to monitoring identified cryospheric components. A CryoNet cluster configuration in OSCAR/surface includes at least one CryoNet station, or at least one CryoNet contributing station and another station providing the GCW-required meteorological observations. Together, these two stations meet the criteria for a CryoNet station. When a cluster encompasses several micro-climatological regions or extends over larger altitudinal gradients, further ancillary meteorological stations may be necessary. The stations included in a CryoNet cluster would generally have different WSIs and may be operated by different institutions, while the coordination and the access to data may be provided through one agency or institute. For registration as a CryoNet cluster in the OSCAR/Surface database, each CryoNet cluster must provide a document indicating the stations included, and an outline of their coordination, data management, programmatic or research approach, the proposed attributes, and other relevant information (such as cooperation between different partners).

Attributes of CryoNet Clusters are:

- Basic – Monitor single or multiple components of the cryosphere.
- Integrated – Monitor at least two components of cryosphere or at least one cryosphere component and one other component of the Earth system. Integrated sites are particularly important for the study of feedback and complex interactions between components.

10.1.2 Global Cryosphere Watch station observational requirements

The observational requirements for each cryosphere component have been identified by GCW. They provide clarity to station operators aspiring to register their stations as GCW stations (CryoNet station, CryoNet contributing, or GCW affiliated) or as CryoNet Clusters.

The cryospheric variables expected to be observed at a GCW station have been identified as recommended or desired.

The *recommended cryospheric variables* are those expected to be observed at candidate CryoNet, CryoNet contributing, and GCW affiliated stations. At least one recommended cryospheric variable is required to be observed at a candidate station. The *desired cryospheric variables* are further cryospheric variables that can be observed at approved GCW stations, and which are not identified as recommended cryospheric variables.

For each variable, the frequency and method (whether automatic or manual) of the observation or measurement are indicated in the *Guide to Instruments and Methods of Observation* (WMO-No. 8), Volume II, 1.4, Tables 1.1-1.11.

The configuration metadata in the OSCAR/Surface database are represented in the WIGOS Metadata Representation (WMDR) defined within the framework of the *WIGOS Metadata Standard* (WMO-No. 1192).

Proponents are invited to use the Site Description field of OSCAR/Surface to provide any additional relevant information which cannot be captured in the available fields, such as station or cluster attributes, and so forth.

10.1.3 List of the recommended cryospheric variables

Note: This section guides the reader on the expected configuration of stations proposed for registration.

For guidance, the following are the recommended cryospheric variables expected to be observed at GCW stations. The detailed list is included in the *Guide to Instruments and Methods of Observation* (WMO-No. 8), Volume II, 1.4, Tables 1.1-1.11. This information is provided as reference in preparation for registering new GCW stations in OSCAR/Surface.

- Snow cover – The recommended observed variables for snow cover include snow depth, water equivalent of snow cover, snow on the ground, solid precipitation, and snow profiles.
- Glaciers and ice caps – The recommended observed variables for glacier and ice caps include surface accumulation (point), surface ablation (point), glacier-wide mass balance, and glacier area.
- Ice sheets – The recommended observed variables for ice sheets are surface accumulation (point), surface ablation (point), and surface mass balance (point).
- Ice shelves – The recommended observed variables for ice shelves are basal ablation and ice velocity.
- Icebergs – The recommended observed variables for icebergs are iceberg position, iceberg form and size, and concentration (distance) of icebergs.
- Permafrost – The recommended observed variables for permafrost are ground temperature and active layer thickness.
- Seasonally frozen ground – The recommended observed variable for seasonally frozen ground is ground temperature.
- Sea ice – The recommended observed variables for sea ice are sea-ice thickness, sea-ice freeboard, sea-ice concentration, sea-ice class, sea-ice type, form of sea ice, stage of ice development, sea ice phenomena (dates of freeze-up, fast-ice formation/breakout, melt onset, break-up), and sea-ice stage of melting.
- Lake ice – The recommended observed variables for lake ice are ice thickness, ice concentration, ice class (pack, fast ice), ice type (level/rafted/ridged and floe descriptor), form of ice (floe size, fast-ice width), stage of ice development, ice phenomena (dates of freeze-up, fast-ice formation/breakout, melt onset, break-up), and ice stage of melting.
- River ice – The recommended observed variables for river ice are ice thickness, ice concentration, ice class (pack, fast ice), ice type (level/rafted/ridged and floe descriptor), form of ice (floe size, fast-ice width), stage of ice development, ice phenomena (dates of freeze-up, fast-ice formation/breakout, melt onset, break-up), ice stage of melting, river-ice jams and dams, flooding extent caused by jams and dams, and river icings (aufeis).

10.1.4 Procedure for registration of Global Cryosphere Watch stations

Process outline

A CryoNet or CryoNet contributing station is evaluated and approved based on the information provided by its proponent in the OSCAR/Surface database. This process has six distinct stages and is summarized in Figure 10.1 below. The stages are:

- (1) **Expression of Interest:** A station operator expresses an interest in registering a CryoNet or a CryoNet contributing station. This is conveyed (either directly or through another party) to the WMO/GCW Secretariat. Preliminary information about the station is shared between the parties.
- (2) **Station Contact:** A Station Contact is agreed upon with the proponent; this is the person responsible for entering the information on the proposed station in OSCAR/Surface. A profile for the Station Contact is created in OSCAR/Surface by the WMO/GCW Secretariat, if not already available.
- (3) **WIGOS Station Identifier (WSI):** Proponents are strongly encouraged to obtain WSIs for their GCW candidate stations from the OSCAR/Surface national focal point of the Member on the territory of which the station is operated. If needed, WMO/GCW Secretariat will facilitate engagement with the appropriate focal point. If a WSI is not obtained from a Member or from another programme, one is allocated by the GCW WSI Issuer, which is the WMO/GCW Secretariat.

Notes:

- (i) For mobile platforms operating in international waters, [OceanOPS](#) will allocate a WSI if the station includes meteorological observations. If a WSI is not obtained from OceanOPS, a WSI will be issued by the WMO/GCW Secretariat.
 - (ii) The WSI is generated according to the guidelines under 10.1.5.
 - (iii) Stations which already exist in OSCAR/Surface as part of other programmes already have a WSI.
 - (iv) Affiliated stations are expected to be already registered in OSCAR/Surface as part of other WMO Programmes, and, thus, have an active WSI.
- (4) **Station entry in OSCAR/Surface:** The Station Contact creates/updates the proposed station in OSCAR/Surface, by entering information in the OSCAR/Surface fields to demonstrate compliance with the requirements defined in the *Manual on the WIGOS*, Chapter 8. Once the draft station is saved, its status in OSCAR/Surface is "Pending". The station must be associated with GCW and the type of stations proposed (that is, CryoNet or contributing). A notification of the new submission will be automatically generated by OSCAR/Surface to the responsible programme authority, which is the WMO/GCW Secretariat.

Notes:

- (i) Instructions for the creation/editing of a station are available in the *OSCAR/Surface User Manual* (OSCAR Series No. 1) and the GCW-specific [FAQ](#) on the OSCAR/Surface platform.
 - (ii) For registration, a candidate station must observe at least one recommended variable listed in section 10.1.3.
 - (iii) If the proponent submits a CryoNet cluster, each new station needs to be entered in OSCAR/Surface, together with an outline of the cluster concept. Once the indicated stations are approved, guidance is provided to link stations belonging to the proposed cluster.
- (5) **Evaluation of the submission:**
- (a) A "Pending" submission is reviewed by the WMO/GCW Secretariat for compliance with the criteria indicated in the *Manual on the WIGOS*, section 8.

- (b) If the submission does not address all requirements as noted at step (4), additional information may be requested from the Station Contact.
- (6) Approval of station: Once all requirements are met, the GCW programme authority changes the status of a station to "Approved". At that point the station is published in OSCAR/Surface as a CryoNet or a CryoNet contributing station.

If the criteria referenced at step four cannot be met, the approval is not granted.

Depending on the status of the proposed station, the registration process will commence at different steps in the outlined process.

Figure 10.1. The process for registering a GCW station

10.1.5 Registration of GCW stations in the OSCAR/Surface database

Allocation of WSI by GCW as an Issuer

When stations proposed as GCW stations (CryoNet or CryoNet contributing) do not obtain a WSI from the Member on the territory of which the station is operated, or from another programme, the WMO/GCW Secretariat will issue a WSI.

The WSI allocated by the WMO/GCW Secretariat will have the following structure:

<i>Block in WSI</i>	<i>Component</i>	<i>Description</i>	<i>GCW ranges</i>
1st block	WSI series	Only the WSI series 0 has been defined. This series is used to identify observing stations.	0
2nd block	Issuer of identifier (number)	This is a five-digit code which would be assigned by WMO to identify a specific Programme or activity with which the identified station is most closely associated. This does not limit the association with other programmes. GCW-issued WSIs will be identified with "21000" for the issuer of identifier.	21000
3rd block	Issue number	This is a number that an organization responsible for issuing an identifier may use to ensure global uniqueness of its identifiers. As GCW is an international activity, the issue number will not identify supervising organizations of GCW stations through this block and will use '0' in this block for all GCW allocated WSI.	0
4th block	Local identifier	This is a string of up to 16 alphanumeric characters used as an individual identifier for each station, to uniquely identify a station, globally. The uniqueness is ensured when used in combination with the other 3 blocks, above. The format issued by GCW will comprise 6 characters, as follows: - Character "C" which has been arbitrarily selected; - 5 characters reserved for the station identifier which will be used sequentially for the applying stations. Notes: - Stations approved as GCW stations before 2020, if receiving WSI through GCW, will receive a WSI for which the last 3 digits represent the ID, as registered in the GCW database; - All stations registered through GCW will receive a WSI in a sequential order starting with C01001.	Cxxxxx

10.2 GLOBAL OCEAN OBSERVING SYSTEM

10.2.1 Introduction

This section provides guidance on WIGOS Station Identifiers (WSIs) to be used by operators of all Global Ocean Observing System (GOOS) in situ observing networks and allocated by [OceanOPS](#) (formerly known as JCOMMOPS) including:

- Ship observations (Voluntary Observing Ships (VOS), Ship-of-Opportunity Programme (SOOP), Automated Shipboard Aerological Programme (ASAP)) under the Ship Observations Team (SOT), and other ship-based systems (fishing vessels, ferry boxes, and so forth);
- Data Buoy observations (global drifter array, tropical moored buoy array, national/coastal moored buoy networks, high latitude (Arctic/Antarctic) buoys, tsunami buoys, unmanned surface vehicles and miscellaneous fixed platforms) under the Data Buoy Cooperation Panel (DBCP);
- Global tide gauge network under the Global Sea Level Observing System (GLOSS);
- Global profiling float array under the Argo programme;
- Fixed-point time series reference sites under OceanSITES;
- Repeat hydrography programme under the Global Ocean Ship-Based Hydrographic Investigations Programme (GO-SHIP);
- Underwater gliders under OceanGliders;
- Animal Borne Instruments under AniBOS;
- Global High-Frequency Radar Network under HFRNet;
- A number of other ocean observing networks emerging at a regional level, or at the boundary of existing Observations Coordination Group (OCG) observing networks.

The WSI scheme for the observing platforms³⁵ of GOOS in situ networks presented here builds on the legacy of existing WMO-identifiers (WMO-ID) traditionally used to distribute observing platform/station data on the Global Telecommunication System (GTS). The WMO-ID allocation scheme for ocean platforms has not always ensured the uniqueness of identifiers and was based on a manual allocation system using a set of complex rules. Some Members also sporadically use some random identifiers that do not meet any defined rule. The scheme described here harmonizes the allocation of station identifiers, ensures their uniqueness, and develops a robust and operational workflow through a machine-based allocation system.

OceanOPS has the delegated authority³⁶ to issue WSIs for ocean observing platforms operated by Members through its Operational Information System. However, if any Member decides to issue the WSIs for their own platforms, they must use the ISO 3166-1 numeric country code “issuer of identifier” number (see section 2.1.4). In such cases, Members should notify OceanOPS³⁷ about those WSIs, when they are assigned, in order to monitor the overall data and metadata flow.

³⁵ OceanOPS commonly uses the term “observing platform”. Other synonyms, such as “station” or “observing facility”, are used by different communities.

³⁶ See the *Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology, Abridged Final Report of the Fifth Session* (WMO-No. 1208), Decision 25 (JCOMM-5)

³⁷ support@ocean-ops.org

10.2.2 Procedures specific to GOOS observing platforms

10.2.2.1 Issuer of identifier

An issuer of identifier code allocated for GOOS observing platforms administered through OceanOPS is a constant: 22000 (see Chapter 2, Table 2.4). The use of the previously defined issuer of identifier codes 20002 (for moored buoys, drifting buoys, fixed platforms), 20003 (observing ship with identifier based on ITU call sign), 20004 (observing ship identifier issued nationally) and 20007 (ship IMO number/hull number) will not be used for new deployed platforms.

10.2.2.2 Issue number

An issue number does not have any meaning and is allocated by the machine to secure uniqueness of the identifier and, for example, to resolve the historical reuse of WMO-IDs. In practice, for OceanOPS platforms, the issue number is used to monitor the different redeployments of the same platform (such as a new mission for a glider), or a new installation of an existing platform/station on a new ship or at a fixed site (such as moored buoys, OceanSITES). Those Members issuing the WSIs for their own platforms will decide on the issue numbers, according to their national schema for WSIs.

10.2.2.3 Local identifier

The local identifier is based generally on the historical WMO-ID or other identifiers defined by observing networks.

The general form of a WMO-ID³⁸ is based on 7 digits:

$$\text{WMO-ID} = A_1B_w \text{ nnnnn}$$

where A_1 = WMO Regional Association³⁹ area and B_w is the sub-area.

B_w is designated against the sub-area (1–7) for moored and drifting buoys, while fixed values 8 or 9 are assigned for other platform types.

Legacy 5-digit WMO-IDs ($A_1B_w\text{nnnn}$)⁴⁰ were converted into 7 digits by adding 00 after the A_1B_w (for example, $A_1B_w00\text{nnnn}$).

However, there are instances when these rules of identifier allocation according to geographical criteria have not been followed (for example, some floats or drifter deployments). While this geographical distinction makes sense for fixed or anchored platforms, it is less appropriate for mobile platforms moving freely or autonomously within different areas, therefore, A_1B_w will be used only for fixed platforms.

Data users should be informed not to base their data extraction or assimilation schemes on the A_1 or A_1B_w formula.

As the WMO-ID (and WSI) allocation system is machine-based, OceanOPS uses the platform deployment location and the WMO area polygons to define A_1 and B_w as appropriate.

³⁸ See the *Manual on Codes – International Codes* (WMO-No. 306), Volume I.2, table Class 01 – BUFR/CREX Identification, Table Reference 0 01 011

³⁹ See the *Manual on Codes – International Codes* (WMO-No. 306), Volume I.1, Page A-243, Table 0161

⁴⁰ See the *Manual on Codes – International Codes* (WMO-No. 306), Volume I.1, Page A-9, List of Code Forms with Notes and Regulations

Table 10.1 below illustrates the new rules that simplify local identifier allocation based on platform types and geographical areas.

While WSI management best practice dictates that the WSI content should have no meaning and be simply unique, the rules proposed in Table 10.1 preserve some of the legacy on the readability of local identifiers by platform types.

Table 10.1. Rules for new local identifier allocation

<i>Platform type</i>	<i>Previous local identifier</i>	<i>New local identifier</i>
Profiling floats, micro floats, ice tethered profilers, polar ocean profiling systems, deep floats, etc.	A ₁ 9nnnnn A ₁ = [1–7]	A ₁ 9nnnnn A ₁ = [1–7] random
Marine animals	99nnnnn	99nnnnn
Subsurface autonomous platforms, gliders	A ₁ 8xxnnn If A ₁ = 4 nnn = 900–999 otherwise nnn = 500–999	89nnnnn
Surface drifters, ice drifters	A ₁ B _w xxnnn nnn = 500–899 xx = 00–99 A ₁ = [1–7], B _w = [1–7]	A ₁ 8nnnnn A ₁ = [1–7] random
Other autonomous surface instruments (saildrones, wave gliders, etc.)	A ₁ 8xxnnn If A ₁ = 4 nnn = 900–999 otherwise nnn = 500–999	A ₁ 0nnnnn A ₁ = [1–7] random
Fixed systems, moored buoys, mooring sites, HF radars, tide gauges, etc.	moored buoys: A ₁ B _w xxnnn nnn = 000–499 xx = 00–99 A ₁ = [1–7], B _w = [1–7] fixed platforms: A ₁ B _w xxnnn nnn = 000–499 xx = 00–99 A ₁ = [1–7], B _w = [1–7]	A ₁ B _w nnnnn nnnnn random A ₁ = [1–7], B _w = [1–7] matching WMO areas/subareas
Any ship-based instruments	ship call sign	7-digit reference (also called SOT-ID) is created randomly by the machine with characters 2, 3 and 7 being letters, the others being letters or numbers (Reference Decision 32 (JCOMM-5))

Reserve of free blocks for future platform types 81nnnnn, 82nnnnn, 83nnnnn, 84nnnnn, 85nnnnn, 86nnnnn, 87nnnnn		

The WIGOS Station Identifiers allocated by OceanOPS will have then the following form:

<i>WIGOS Identifier Series (number)</i>	<i>Issuer of Identifier (number)</i>	<i>Issue Number (number)</i>	<i>Local Identifier (characters)</i>
0	22000	0 to 65534	7-digit string

10.3 GLOBAL ATMOSPHERE WATCH

10.3.1 Introduction

10.3.1.1 Background

The [WMO Global Atmosphere Watch \(GAW\) Implementation Plan: 2016–2023](#) (GAW Report No. 228) explains how observing facilities (stations) can become affiliated to the WMO GAW Programme as either Global, Regional, Local or Mobile GAW Stations, or as a station of a Contributing Programme.

Note: The specifications provided in the referenced GAW implementation plan remain valid beyond the specified period of the plan.

All observing facilities, including those from other GAW related programmes (“GAW Other Elements”), need to be registered in the GAW Station Information System (GAWSIS) to be considered for affiliation with GAW. GAWSIS is the WMO designated catalogue of surface-based observing facilities, and represents the metadata source for OSCAR/Surface for GAW observations.

When registered in GAWSIS, at least one WIGOS Station Identifier (WSI) is assigned to each observing facility. Additional programme-specific identifiers can be assigned but are not the subject of this Guide. Only stations that measure GAW variables can be affiliated with the programme as either Global, Regional, Local or Mobile GAW Stations, or as a station of a Contributing Programme, following regulations outlined in the *Manual on the WIGOS*, Chapter 6.

GAW is recognized as an “Issuer of WIGOS Station Identifiers” (or WSI Issuer) with delegated authority to issue WSIs for observing stations that contribute to the GAW Programme. The following sections describe the process of issuing and assigning a WSI for a GAW-related station, in compliance with section 2.1, in order to register an observing facility under GAW.

10.3.1.2 Programmes/networks under Global Atmosphere Watch

The application procedure to become affiliated with the GAW Programme is described in the WMO Global Atmosphere Watch (GAW) Implementation Plan: 2016–2023 (GAW Report No. 228), Annex B, and in the Manual on the WIGOS, section 6.2. It involves registration with GAWSIS-OSCAR/Surface and approval by a governing body, depending on the type of programme affiliation desired. The structure of programmes/networks organized under GAW is specified under the WMO Codes Registry (codes.wmo.int/wmdr/ProgramAffiliation).

10.3.2 WSI procedures specific to Global Atmosphere Watch observing facilities

10.3.2.1 Issuer of identifier for observing facilities registered by a Member

Institutions wishing to register and affiliate observing facilities for a programme/network under GAW may do so by contacting the national focal point (NFP) for GAW of the WMO Member in which the station is located, who is nominated by the respective Permanent Representative. The NFP for GAW in coordination with the OSCAR/Surface NFP will then create/register a station in GAWSIS-OSCAR/Surface. The issuer of identifier should be the ISO 3166-1 numeric code assigned to the corresponding country or territory.

10.3.2.2 Issuer of identifier for observing facilities registered through the Global Atmosphere Watch Programme

If a Member is unable to issue a WSI, the WMO Secretariat will do this. In such a case, the institution wishing to register a GAW station, and the Member concerned (according to the previous paragraph) will contact the WMO Secretariat. The Secretariat will then analyse the request, decide upon the registration of the station in GAWSIS-OSCAR/Surface and assign a WSI for the GAW Programme. The issuer of identifier value for observing facilities affiliated with GAW is 20008.

10.3.2.3 Issuer number for observing facilities registered through the Global Atmosphere Watch Programme

To guarantee global uniqueness, the WMO Secretariat responsible for support of the GAW Programme has assigned a unique issue number to World Data Centres (0), to each Programme/network contributing to GAW wishing to register additional observing facilities (100–199), and to other elements that are performing atmospheric composition measurements (200–299) in GAWSIS-OSCAR/Surface, as listed in Table 10.2. This list is maintained by the WMO Secretariat and is available from the WMO Codes Registry (codes.wmo.int/wmdr/ProgramAffiliation).

10.3.2.4 Local identifier for observing facilities registered through the Global Atmosphere Watch Programme

The local identifier in the WSI corresponds to the 3-letter GAW ID. At present, GAW IDs are managed in GAWSIS-OSCAR/Surface. All GAW related observing facilities must be assigned a 3-letter GAW ID, which limits the number of possible GAW IDs to a total of 17 576 from AAA to ZZZ. The requirement for a 3-letter GAW ID may be dropped in future in favour of a more flexible approach.

10.3.2.5 Global Atmosphere Watch Programme-specific identifiers

Managers of programmes/networks under GAW may wish to document up to one programme-specific station identifier in GAWSIS-OSCAR/Surface in addition to the WSI. There are no constraints on such identifiers, and GAWSIS-OSCAR/Surface makes no attempt at guaranteeing global uniqueness of such identifiers, which is beyond the scope of this Guide.

Table 10.2. List of the issue number initially assigned to GAW World Data Centres and programmes/networks affiliated with GAW

<i>Issue number</i>	<i>Programme or network name</i>	<i>WMDR notation</i>
0	WDCs	--
1 ... 99	Reserved	--
100	ADNet	http://codes.wmo.int/wmdr/ProgramAffiliation/ADNet
101	CASTNET	http://codes.wmo.int/wmdr/ProgramAffiliation/CASTNET
102	EANET	http://codes.wmo.int/wmdr/ProgramAffiliation/EANET

Issue number	Programme or network name	WMDR notation
103	EARLINET	http://codes.wmo.int/wmdr/ProgramAffiliation/EARLINET
104	IAGOS	http://codes.wmo.int/wmdr/ProgramAffiliation/IAGOS
105	IMPROVE	http://codes.wmo.int/wmdr/ProgramAffiliation/IMPROVE
106	INDAAF	http://codes.wmo.int/wmdr/ProgramAffiliation/IDAF
107	LALINET	http://codes.wmo.int/wmdr/ProgramAffiliation/LALINET
108	MPLNET	http://codes.wmo.int/wmdr/ProgramAffiliation/MPLNET
109	NADP	http://codes.wmo.int/wmdr/ProgramAffiliation/NADP
110	TCCON	http://codes.wmo.int/wmdr/ProgramAffiliation/TCCON
112	NDACC	http://codes.wmo.int/wmdr/ProgramAffiliation/NDACC
113 ... 199	Reserved	--
200	AEROCAN	https://codes.wmo.int/wmdr/ProgramAffiliation/AEROCAN
201	German AOD Network	http://codes.wmo.int/wmdr/ProgramAffiliation/germanAODnetwork
202	PHOTONS	http://codes.wmo.int/wmdr/ProgramAffiliation/_PHOTONS
203	PolarAOD	http://codes.wmo.int/wmdr/ProgramAffiliation/_polarAOD
204	SKYNET	http://codes.wmo.int/wmdr/ProgramAffiliation/_skynet
205	SibRad	http://codes.wmo.int/wmdr/ProgramAffiliation/_sibRad
206	CAPMoN	http://codes.wmo.int/wmdr/ProgramAffiliation/CAPMoN
207	CLN	http://codes.wmo.int/wmdr/ProgramAffiliation/CLN
208	EMEP	http://codes.wmo.int/wmdr/ProgramAffiliation/_EMEP
209	SHADOZ	http://codes.wmo.int/wmdr/ProgramAffiliation/_SHADOZ
210	CIS-LiNet	http://codes.wmo.int/wmdr/ProgramAffiliation/_CIS-LiNet
211	ACTRIS	http://codes.wmo.int/wmdr/ProgramAffiliation/_ACTRIS
212	AGAGE	http://codes.wmo.int/wmdr/ProgramAffiliation/_AGAGE
213	AERONET	http://codes.wmo.int/wmdr/ProgramAffiliation/_AERONET
214	NOAA-GML	http://codes.wmo.int/wmdr/ProgramAffiliation/_NOAAGML
215 ... 65555	Reserved	

10.4 WMO RADAR DATABASE

10.4.1 Introduction

The WMO Radar Database (WRD), currently maintained and operated on behalf of WMO by the Turkish State Meteorological Service (TSMS), is the recommended portal through which WMO Members should submit their operational weather radar metadata in support of OSCAR and the WMO Rolling Review of Requirements – see [Chapter 3, section 3.3.1.3](#).

10.4.2 Allocation of WSIs to weather radar stations by WMO Radar Database

In relation to the assignment of WIGOS station identifiers for weather radar stations, if not provided by the responsible Member within OSCAR/Surface, the WRD has authority to assign identifiers for weather radar stations utilizing a specific issuer of identifier code. The assignment of WIGOS identifiers is then made using the following schema as described and depicted in Figure 10.2 below.

- A WIGOS identifier in the form <0.20010.0.WMO-No> will be assigned for weather radar stations, to be registered in WRD, that were operational before 1 July 2016, with a previously assigned WMO-No of the form NNNNN.
- For all other weather radars, the WRD will assign a WIGOS identifier using the WRD-specific issuer of identifier (21010) and a local identifier assigned by the WRD and confirmed as unique with respect to all radars in the WRD. In such cases the WIGOS identifier will therefore take the form: <0.21010.0.WRD-Lid>, where “WRD-Lid” will be a simple series of integers.

Figure 10.2. WRD WIGOS identifier assignment**10.4.3 Registration of weather radar stations and synchronization with OSCAR/Surface**

- (1) A weather radar station can be registered in the WRD by a NFP nominated by the Permanent Representative of the WMO Member where the weather radar is located.
- (2) The assigning of WSIs is automatically done by WRD, which then synchronizes the weather radar's metadata with that in OSCAR/Surface.
- (3) A WSI will be assigned to a weather radar station only if the following minimum metadata elements are provided:
 - (a) Radar station name
 - (b) Country
 - (c) Station operating status
 - (d) Supervising organization
 - (e) Station type
 - (f) Installation date
 - (g) Latitude
 - (h) Longitude
 - (i) Elevation
 - (j) Owner name

10.5 WMO HYDROLOGICAL OBSERVING SYSTEM**10.5.1 Allocation of WIGOS Station Identifiers for hydrological stations**

The purpose of this section is to provide guidance on the recommended procedures for allocating WIGOS Station Identifiers (WSIs) for hydrological stations.

Members may include in the WSIs for hydrological stations references to national or local classification schemes, as described below. Therefore, organizations issuing WSIs for hydrological stations are strongly advised to document their procedures in their quality management system. Figure 10.3 indicates the various elements that make up a WSI for hydrological stations.

Figure 10.3. Structure of WIGOS Station Identifier for hydrological stations

Note: The International Hydrological Code (IHC) (from the *Manual on Codes* (WMO-No. 306), Volume II: see section F of each regional Chapter) is a hydrological observing station identification number. It allows the identification of the WMO Region (A), country (Ci), river basin or group of basins (BB) and the station (iHiHiH). The lists of Ci and BB are published in the *Manual on Codes* (WMO-No. 306), Volume II, while the iHiHiH value has to be set in a unique way at the national level.

10.5.1.1 Procedure A

In Procedure A (see, for example, Table 10.3), hydrological stations are registered through the NFP on WIGOS of the Member issuing the WSI, where the issuer of identifier is identified by its ISO 3166 Country Code (three digits).

The Member defines its own national schema for assigning the issue number and the local identifier. As this can be quite overwhelming and some Members might not have an agreed schema, procedures A1 and A2 below are proposed options.

Table 10.3. Structure of WSI for A1 and A2 procedures

<i>Procedure</i>	<i>WIGOS Identifier Series</i>	<i>Issuer of Identifier ISO Country Code</i>	<i>Issue number</i>	<i>Local Identifier</i>
A1	0	1-999	0	To be defined by Member
A2	0	1-999	1-99 (national organizations)	To be defined by organization

Procedure A1

The Member assigns 0 to the Issue number, and directly provide a local identifier. The Member may choose to use an existing national identifier as the local identifier for the observing facility (station).

Table 10.4 illustrates this procedure, with Canada as an example of the issuer of identifier and with the local identifier being the Hydrometric Station Number Index for the Yukon river at Dawson, used by the Water Survey of Canada.

Table 10.4. Example of A1 procedure

<i>WIGOS Identifier Series</i>	<i>Issuer of Identifier Canada ISO Code</i>	<i>Issue number</i>	<i>Local Identifier Hydrometric Station Number Index (Yukon river at Dawson)</i>
0	124	0	09EB001 ⁴¹

The advantage of this procedure is that it simplifies the process by having a single Issuer of WSIs (the Permanent Representative via the NFP) and by fixing the issue number to 0. The disadvantage might be a slower process of allocating identifiers, as it depends on one entity (usually the National Meteorological Services), to which all other organizations must refer.

Procedure A2

The Member chooses to define the issue number, to allow delegation of the task of allocating WSIs in which the local identifiers are issued by various entities responsible for managing individual observing networks. These organizations could be the National Meteorological Service, National Hydrological Service, National Transport Departments, Environmental Agencies, and so forth.

If the organization is only responsible for allocating local identifiers for their WSIs, then it is sufficient for it to ensure that it does not assign the same local identifier to more than one

⁴¹https://wateroffice.ec.gc.ca/station_metadata/station_index_e.html?type=stationName&stationLike=A

observing facility under its responsibility. It may choose to use an existing national identifier as the local identifier for the observing facility or to define new identifiers.

Brazil, Côte d'Ivoire and Italy proposed their own national WSI allocation schemas, which all follow procedure A2, but in three different ways, as shown by way of example in Table 10.5.

Table 10.5. Examples of A2 procedure

<i>WIGOS Identifier Series</i>	<i>Issuer of Identifiers ISO Country Code</i>	<i>Issue number National organizations</i>	Local Identifier
0	(Brazil) 076	(NMET) 100 (DECEA) 101 (DHN) 102 (ANA) 103 (...)	GGGGGGGTTNNNNN ⁴²
	(Côte d'Ivoire) 384	(NMS stations) 1–199 (NMS partners' stations) 200–299 (...) 9000–9999	To be defined by organization
	(Italy) 380	1-2-3-(...)	1-2-3-(...)

The benefit of Procedure A2 is that multiple entities are issuing identifiers. Therefore, local identifiers will be categorized, and the process of registration may be faster. One possible disadvantage would be the non-uniqueness of local identifiers.

Based on these two procedures, the risk of allocating the same identifier to different stations is managed in procedure A1 by the presence of a unique issuing entity, and in procedure A2 by the presence of several issuing entities with unique issue numbers.

Procedure A1 can adapt well to Members with a hydrometeorological service having relations with other hydrological monitoring institutions. Procedure A2 is better suited to a national context, with several entities in charge of the monitoring. However, Members may choose to follow either procedure A1 or procedure A2.

10.5.1.2 Procedure B

In the case where it is challenging to obtain WSIs from the Permanent Representative of the Member, the alternative procedure is to allocate WSIs for hydrological stations via a delegated authority from the observing component of the WMO Hydrological Observing System (WHOS) in case of non-meteorological service observing stations, that is, research organizations, basin authorities/organizations, and so forth. This procedure is characterized by a worldwide unique issuer of identifier that directly identifies the station as a provider of hydrological data (see, for example, Table 10.6). The allocation of WSIs for hydrological stations in this procedure is the responsibility of the WMO Secretariat.

Table 10.6. Structure of WSI for B procedures

<i>Procedure</i>	<i>WIGOS Identifier</i>	<i>Issuer of Identifier WHOS</i>	Issue number	Local Identifier
B1	0	21XXX	0	ACiBBiHiHiH (International Hydrological Code)
				To be defined by:

⁴² GGGGGGGG = Official County Geocode; TT = Type of station; NNNNN = Station number (new or old WWW number)

				• WHOS or • Organization
B2	0	21XXX	ACiBB (Basin indicator)	To be defined by: • WHOS or • Organization

Procedure B1

In procedure B1, the issue number is fixed to the 0 value and there are two options for the local identifier: the International Hydrological Code (IHC) or another identifier defined by WHOS.

The IHC (from the *Manual on Codes* (WMO-No. 306), Volume II: see section F of each regional Chapter) is a hydrological observing station identification number. It allows the identification of the WMO Region (A), country (Ci), river basin or group of basins (BB) and the station (iHiHiH). The lists of Ci and BB are published in the *Manual on Codes* (WMO-No. 306), Volume II, while the iHiHiH value has to be set in a unique way at the national level.

The same example as set out in Table 2 with the Yukon river in the Yukon basin (Canada) is used in Table 10.7. The value allocated to WHOS is simply for illustration. The local identifier refers to the WMO Region (4), country (2), river basin (03) and station (010 given randomly).

Table 10.7. Example of B1 procedure

WIGOS Identifier Series	Issuer of Identifier WMO WHOS	Issue number	Local Identifier
0	21016	0	4203010

The IHC is not widely used by Members. Because of the two-digit number for the basin (BB), some small basins are grouped into one: it is necessary to check in order to ensure that these basin indicators are coherent with basin authorities/organizations. Also, this basin identification system might just complexify the allocation of WSIs.

Procedure B2

In the case of Procedure B2, a part of the IHC is allocated to the issue number. The region (A), country (Ci) and basin (BB) identifiers are used (see, for example, Table 10.8). Procedure B2 enables the issuer of an identifier to categorize stations, allows basin organizations to issue WSIs independently and limits duplicates.

Table 10.8. Example of B2 procedure

WIGOS Identifier Series	Issuer of Identifier WMO WHOS	Issue number	Local Identifier
0	21016	4203 (Basin indicator)	To be defined by: (i) WHOS or (ii) Organization

The Global Runoff Data Centre (GRDC) has produced maps of the WMO Hydrologic Regions and Subregions and a numbering system derived from the region and basin indicators used in Table 10.6 (see [Example of a WMO hydrological regions and sub-regions numbering system](#)). It illustrates well the concept applied for the issue number in this procedure.

10.6 COPERNICUS CLIMATE CHANGE SERVICE

10.6.1 Introduction

10.6.1.1 Background

The Copernicus Climate Change Service (C3S) is managed by the European Centre for Medium-Range Weather Forecasts (ECMWF), the entity entrusted by the European Commission. The service exists to enable access to and use of climate data by a broad range of stakeholders. Data served includes observational data, observationally-based data products, including reanalyses, and climate model data.

10.6.1.2 Activities of relevance under Copernicus Climate Change Service

The C3S programme includes a set of contracts concerned with recovery, management and provision of historical in situ data holdings from a variety of observing platforms in support of climate applications. The work is undertaken in partnership with other entities including the World Data Centre for Meteorology-Asheville (hosted by the National Centers for Environmental Information of the United States' National Oceanic and Atmospheric Administration (NOAA-NCEI)).

The holdings being managed under these activities contain data for many tens of thousands of stations (which include marine platforms), many of which are long-closed stations which may previously have been operated individually by National Meteorological and Hydrological Services (NMHS) or their antecedent organizations, or which have only ever been operated by third parties. To be able to provide access to users to these climate data holdings, using WSIs, requires those stations without a currently assigned identifier to be assigned a WIGOS identifier.

10.6.2 WSI procedures specific to Copernicus Climate Change Service

10.6.2.1 Copernicus Climate Change Service check for existing WIGOS identifier

A first step for every station to be issued a new WSI by C3S is for C3S to check whether it is registered in [OSCAR/Surface](#) under an existing WSI. If it is, that identifier will be used by C3S and no further action is required. The check will involve multiple metadata aspects (station name, including possible antecedent names such as colonial place names, country, coordinates, and so forth) to ensure that the station is truly unique within OSCAR/Surface.

10.6.2.2 Check for stations still in operation

For some data used by C3S, the station is presently operational but has no WSI. This could arise because the station is owned/operated by citizen science programmes (such as the Community Collaborative Rain, Hail and Snow Network (CoCoRAHS)) or by a non-NMHS data provider (for example, various mesonets) and has not been registered in OSCAR/Surface. For such stations still in operation, a check will be made with the PRs of the relevant Members as to whether they plan to assign them a WSI and register them in OSCAR/Surface in the first instance. C3S will proceed to issue a WIGOS identifier, in accordance with the Manual on the WIGOS, Attachment 2.2., only for those stations whose PRs do not plan to register or do not reply within a reasonable time frame, and to register the station in OSCAR/Surface.

10.6.2.3 Issuer of identifier for Copernicus Climate Change Service

The issuer of identifier codes for all WSIs issued by C3S is 23001, as per Table 2.5 in 2.4.4.

10.6.2.4 Issuer number for Copernicus Climate Change Service

The issuer number for C3S identifier block assignments is based upon the in situ contractor responsible for issuing the identifier as per Table 10.9. Each in situ contract lead entity is responsible for managing the local identifiers issued under its issuer number. There are presently three contracts in operation, each of which has been assigned an issuer number. The three contracts are coordinated by ECMWF and agreements are in place as to how to manage the data overlaps where they exist. Paul Poli is the C3S In situ Observations Manager (paul.poli@ecmwf.int) coordinating the assignment of WSIs on behalf of ECMWF.

Table 10.9. Issuer number details for Copernicus Climate Change **Service including** the observation types likely to be registered (current as of 26/7/22)

Issuer	Issuer number	Responsible entity	Contact	Type of data
C3S2 311 Lot 1	1	Maynooth University (Ireland)	Peter.thorne@mu.ie	Global land and marine surface observations
C3S2 311 Lot 2	2	National Research Council (CNR) (Italy)	Fabio.madonna@imaa.cnr.it	Radiosonde and upper-air remote sensing
C3S2 311 Lot 3	3	Royal Netherlands Meteorological Institute (KNMI) (Kingdom of the Netherlands)	gerard.van.der.schrier@knmi.nl	Land surface observations over the European domain at daily resolution

10.6.2.5 Local identifier for Copernicus Climate Change Service

C3S will observe and honour the rules for all WSI local identifiers as set out in preceding sections. An identifier of up to 16 characters (avoiding spaces and reserved special characters) will be assigned to each station. These WSI local identifiers will avoid any use of information that may point to a specific location or data type being available.

To aid users and Members, and for historical legacy purposes, under issuer number 1 for this block for some stations registered that appear in the Global Historical Climatology Network daily (GHCNd) and monthly (GHCNm) archives, the FIPS code (<https://www.geodatasource.com/resources/tutorials/international-country-code-fips-versus-iso-3166/>) may constitute the initial characters in the local identifier. This identifies the territory but without prejudice as to the exact station location or the type of observations that are/were being performed.

An example of such a station is given at <https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:US1NCBC0121/detail>. In the C3S issuer identifier schema, assuming the corresponding PR did not wish to register the station, this station would be assigned 0-23001-1-US1NCBC0121 which would enable backward compatibility to the GHCNd holdings. The FIPS code usage is a historical legacy of NOAA-NCEI practices.

This practice would pertain only to issuer number 1 under the 23001 block and would be limited to stations with legacy use in existing global holdings managed by NOAA-NCEI.

10.6.3 Resolving subsequent identifier conflicts

The C3S identifier is a low-ranking identifier. NMHS are encouraged to periodically review the C3S WSI holdings registered in OSCAR/Surface and are encouraged to claim identifiers for those stations under their auspices, augmenting available metadata where possible. Where an NMHS wishes to claim stations initially registered under the C3S issuer of identifier, the C3S

will use the new national identifier registration in all applications. The C3S-based identifier will point to the nationally registered identifier which will take precedence within OSCAR Surface.

10.7 _____ SPACE BASED SUBSYSTEM OF WIGOS

10.7.1 _____ Assignment and allocation of WSIs for satellites in WIGOS

The purpose of this section is to provide guidance on the recommended procedures for allocating WSIs for satellites in the space-based subsystem of WIGOS.

As satellites are not often owned and operated by WMO Members and as they are not always part of any national observation network, WIGOS station identifiers for satellites are assigned by WMO Space Programme, in collaboration with the entity responsible of the satellite (for example, a Member, a space agency or another owner of the satellite). The assignment of WIGOS station identifiers is then made using the following schema as described in 10.7.2.

10.7.1 _____ WSI scheme for satellites

As described in 2.4, the WMO Space Programme has been allocated the Issue of Identifier value of 20009 within the WSI for the satellites launched before July 2016. According to 2.4.2, Issue of Identifier value of 21009 is used for the satellites launched after July 2016. The Issue Number is set to 0, and the Local Identifier is set according to the three-digit identifier given in Common Code Table (CCT) C-5, using leading zeroes as needed. CCT C-5 was defined to allow a consistent approach across all the code forms.

For each satellite, CCT C-5 specifies the code figure for I6I6I6 and the corresponding code figures for BUFR and GRIB. The entries in the table are grouped in the following way:

- Even deciles indicate polar orbiting satellites, for example 223 is the entry for NOAA 19 launched in 2009 (the decile is 22).

The example of the assigned WSIs is: NOAA 19 0-20009-0-223;

- Odd deciles indicate geostationary satellites, for example 174 is the entry for Himawari-9 launched in Nov 2016, and then Issue of Identifier is 21009 (the decile is 17)

The example of the assigned WSIs is: Himawari-9 0-21009-0-174.

This approach ensures a very simple mapping between CCT-C5 and the WSI. It does not, however, address the embedding of implicit metadata such as the use of the decile value to describe the type of orbit within the CCT-C5 value assignment. There is scope to use the Issue Number in order to make this information explicit.

10.7.1.1 _____ Recording WSIs in WMO OSCAR/Space

The WMO Observing System Capability Analysis and Review tool for space-based capabilities (OSCAR/Space) is a publicly available, online resource established and maintained by the WMO Space Programme Office (WMO SP) in the context of the WMO Integrated Global Observing System (WIGOS). OSCAR/Space It contains information on more than 900 satellites and 1100 instruments.

WSIs shall be recorded in OSCAR/Space portal within the details recorded for each satellite, see for example https://space.oscar.wmo.int/satellites/view/metop_c. WMO Space Programme is responsible to update and maintain the WSI records in OSCAR/Space.

11. THE GLOBAL BASIC OBSERVING NETWORK

11.1 INTRODUCTION

The WMO Global Basic Observing Network (GBON), designed and defined at a global level, is the basic surface-based observing network that is essential to support Global Numerical Weather Prediction (NWP). GBON is a component of the surface-based subsystem of the WMO Integrated Global Observing System (WIGOS), used in combination with the space-based subsystem and other surface-based observing systems of WIGOS, to contribute to meeting the requirements of global NWP, including reanalysis in support of climate monitoring.

Over the last several decades, NWP has emerged as the common foundation of all weather and climate services for nations big and small. Thus, Members are increasingly depending on model data products provided by global and regional modelling and prediction centres for the generation and delivery of services to their constituencies. However, these centres and products are in turn completely reliant on a constant supply of reliable observations from all parts of the globe to ensure the quality of their weather and climate products.

Figure 11.1. Surface land pressure observations received by one or more WIGOS monitoring centres on 2 January 2023, 00 UTC. (Colour coding relates to GBON baseline requirements: fully-reporting stations are shown in green, partly-reporting stations in orange or red, silent (non-reporting) stations in black, and stations that report at a frequency greater than required by GBON in pink).

Note: WIGOS monitoring centres are global NWP centres contributing to the WIGOS Data Quality Monitoring System (WDQMS), namely, the German weather service Deutscher Wetterdienst (DWD), the European Centre for Medium-range Weather Forecasts (ECMWF), the Japan Meteorological Agency (JMA) and the United States National Centers for Environmental Prediction (NCEP).

In figure 11.1 (from January 2023), large gaps exist over land and sea where essential surface-based observations are missing. For instance, surface pressure observations are not available to WIGOS monitoring centres from stations that are silent ("non-reporting"), shown by black dots. Red or orange dots show where observations are available but are not currently shared internationally at the required temporal frequency.

In response to the persistent geographical gaps in data coverage, the adoption of GBON by the WMO Members represents a new approach in which the basic surface-based observing network, necessary for feeding the NWP models with input data, is designed, defined and monitored at the global level.

Improvements in the international exchange of observational data due to GBON will flow through the weather value chain to deliver benefits that are estimated to amount to more than 5 billion US dollars annually (see the information brief *[The Value of Surface-based Meteorological Observation Data: Costs and Benefits of the Global Basic Observing Network](#)*).

The benefits of increasing surfaced-based observations through GBON will be felt most over areas from which observations are currently missing, including some of the regions that are most vulnerable to climate change and its impacts. However, given the global nature of weather and climate, benefits of GBON will be realized both in the countries where the improvements are made and across the globe.

In order for WMO Members to fully implement GBON and realize the benefits mentioned above, additional investment and capacity development will be needed for many developing countries. WMO is therefore working closely with the international development and climate finance

communities to facilitate this, including through the establishment of the Systematic Observations Financing Facility (SOFF). More information on how SOFF is working to help close the GBON gap can be found in the [SOFF Operational Manual](#).

The provisions in the *Manual on the WIGOS*, section 3.2.2, relating to GBON are based on current observational requirements for global NWP as defined by technical experts working under the WMO Commission for Observation, Infrastructure and Information Systems (INFCOM) and the Global Climate Observing System. Drawing on more than 20 years of NWP observational data impact studies coordinated by WMO, the provisions specify – in clear, quantitative terms – the obligations of WMO Members to acquire and exchange these critically needed observations: which parameters to measure, how often, at what horizontal and vertical resolution, and which measurement techniques to use.

Satellites provide global coverage and can measure parameters for both atmosphere and surface, and satellite data make a very substantial contribution to forecast skill. However, global NWP systems still have a critical reliance on surface-based observations for certain key parameters that cannot yet be reliably measured from space: in particular, atmospheric surface pressure, the vertical distribution of winds and subsurface ocean parameters. Surface-based observations are essential over land and over snow and ice surfaces; they are essential tools for verification of model predictions, and they play critical roles for calibration and validation of space-based data.

Given the critical role of surface-based observations and the persistent gaps in the surface-based observing networks, the GBON regulations currently encompass surface-based data only. The implications of the WMO Unified Data Policy for satellite data are still being elaborated between WMO and the satellite operators.

11.2 GBON REQUIREMENTS

11.2.1 GBON standard requirements

The overall purpose of GBON is to secure adequate supply of observational data to the global NWP centres that serve all Members with model products. “Adequate supply” means (i) measurement of the most important variables, (ii) measurements made at a sufficient spatial density, and (iii) measurement reported at a sufficient temporal frequency.

The variables to be observed by Members at a set of surface land stations/platforms are, at a minimum, atmospheric pressure (SLP), air temperature (T), humidity (H), horizontal wind (W), precipitation (P) and snow depth (SD), where applicable.

The variables to be observed by Members at a set of upper-air stations/platforms over land are, at a minimum, air temperature (T), humidity (H) and horizontal wind (W).

The variables to be observed by Members at a set of surface marine meteorological observing stations/platforms within their Exclusive Economic Zone, or the corresponding marine areas of their jurisdictions, are, at a minimum, atmospheric pressure (SLP) and sea-surface temperature (SST).

[Guidance on the measurement of all variables specified for GBON is provided in the Guide to Instruments and Methods of Observation \(WMO-No. 8\).](#)

Table 11.1 below provides a summary of station-level GBON requirements for different types of observing stations in terms of space and time requirements according to the “shall” (bold) and “should” provisions of GBON.

Table 11.1. Summary of GBON requirements for different types of observing stations, with “shall” provisions in bold type

	Horizontal Resolution	Vertical Resolution	Observing cycle	Variables	Other requirements
Surface land stations	200 km ⁴³ 100 km ⁴⁴	n/a	1 h	SLP, T, H, W, P, SD	Exchanged in real time through WIS 2.0
Upper-air stations operated from land	500 km ⁴⁵ 200 km	100 m	2/24 h	T, H, W	Up to 30 hPa, exchanged in real time through WIS 2.0
Subset of upper-air stations	1 000 km ⁴⁶	100 m	24 h	T, H, W	Up to 10 hPa, Exchanged in real time through WIS 2.0
Surface marine stations in Exclusive Economic Zones	500 km	n/a	1 h	SLP, SST	Exchanged in real time through WIS 2.0
Upper-air stations operated in Exclusive Economic Zones	1 000 km	100 m	2/24 h	T, H, W	Up to 30 hPa, exchanged in real time through WIS 2.0
Aircraft data	100 km at flight level	300 m for profiles	1 h	T, H, W	Data exchange per licensing agreement
Remote sensing profiler observations	Where available	100 m	1 h	T, H, W	n/a

11.2.2 GBON high-density network requirements

GBON high-density requirements apply where Members operate networks of surface land observing stations/platforms at horizontal resolutions of 100 km or higher, and networks of upper-air stations/platforms providing horizontal resolutions of 200 km or higher. According to the *Manual on the WIGOS*, sections 3.2.2.8 and 3.2.2.13, Members should operate their networks at such density. At the same time, sections 3.2.2.9 and 3.2.2.16 respectively, state that Members who do operate at these higher densities shall make all GBON observations available internationally through WIS in real time or near-real time.

Accordingly, for surface land observing networks, GBON compliance monitoring will be performed against both the 200 km standard density and 100 km high-density requirement, providing two distinct targets, regardless of whether Members are operating their networks in the standard or high-density configuration.

⁴³ For Members whose surface area of the Exclusive Economic Zone (EEZ) is significantly larger than the land surface area, the horizontal resolution for surface land stations is defined at 500 km, applied to the entirety of the area of observing responsibility including land surface and EEZ. These Members retain responsibility for Surface marine stations in EEZs.

⁴⁴ High-density requirement is mandatory for data exchange where capability exists. See details in section 11.2.2.

⁴⁵ For Members whose surface area of the EEZ is significantly larger than the land surface area, the horizontal resolution for the upper-air stations operated in the EEZ is defined at 1000 km, applied to the entirety of the area of observing responsibility including land surface and EEZ.

⁴⁶ Requirement is mandatory for data exchange where capability exists.

Similarly, for upper-air networks, the GBON compliance monitoring will be performed against both the 500 km standard density and 200 km high-density requirement.

GBON compliance reports will then show which Members are operating their surface land and upper-air networks at high density and which Members are operating them at standard density configuration.

11.2.3 Interpretation of horizontal resolution requirements for GBON land stations/platforms

The GBON target numbers of the surface land stations and upper-air stations over land were initially communicated to Members through the WMO GBON Global Gap Analysis in January 2022. Those numbers are the defining target for assessing Member's GBON compliance. They were determined by dividing the land surface area of the Member, or a sum of the land surface area and EEZ surface area for SIDS, by the respective horizontal resolution (Table 11.1) squared. In specific cases, where the size or shape of the Country/Territory does not allow to properly address the GBON target requirements calculated in the explained way, Members may wish to adjust the calculation method and determine their own network station distribution. In such cases, the WMO Secretariat should be consulted and/or an exemption under Article 9 of the WMO Convention can be requested. Regardless of the number of stations that can be sponsored by different initiatives and that can ensure a higher than the required number of stations, the GBON target number for compliance monitoring remains the same as defined for the standard density requirements. Members who operate networks with densities higher than the high-density requirements, are encouraged to assign such stations to GBON and make data from those stations available internationally through WIS.

11.3 ASSIGNMENT OF GBON STATIONS/PLATFORMS

11.3.1 Process for the assignment of GBON stations/platforms

The composition of GBON is updated according to the proposals of Members with regard to the assignment of GBON stations/platforms in OSCAR/Surface.

Members have the authority to assign stations/platforms to GBON, either on the basis of the global gap analysis or one performed by the Member.

All marine stations/platforms registered in OSCAR/Surface that report observations of the variables defined in provisions 3.2.2.10 and 3.2.2.15 are considered GBON stations/platforms, due to the short life span and moving nature of many of the observing platforms.

The process to be followed by all stakeholders for the monitoring of GBON stations is regulated according to Appendix 3.1 of the *Manual on the WIGOS* and is reproduced here for convenience:

1. The list of GBON stations/platforms is drawn from the list of all available stations/platforms in WIGOS as registered in OSCAR/Surface, and monitored by the WDQMS for data quality.
2. The assignment of the subset of Member's stations/platforms to GBON is based on sections 3.2.2.7–3.2.2.10 and 3.2.2.12–3.2.2.15.

Note: All marine stations/platforms registered in OSCAR/Surface that report observations of the variables in defined in provisions 3.2.2.10 and 3.2.2.15 are considered GBON stations/platforms.

3. INFCOM undertakes a regular analysis of the status of the GBON implementation that provides, for each Member, the number of surface stations/platforms and the number of

upper-air stations/[platforms](#) that are required for the Member to meet its obligations under 3.2.2.7–3.2.2.10 and 3.2.2.12–3.2.2.15.

4. For each Member, INFCOM reviews its [assigned](#) contribution as per 3.2.2.21 and assesses whether it meets the requirements specified in 3.2.2.7–3.2.2.10 and 3.2.2.12–3.2.2.15, and informs the Member in writing of its findings.

5. The maintenance of GBON [stations/platforms](#), the [new assignment](#) or removal of GBON [stations/platforms](#) are made and recorded in OSCAR/Surface by [Members'](#) national focal points for OSCAR/Surface. All [assigned](#) GBON [stations/platforms](#) will then automatically appear on the dedicated GBON web tool.

[Notes:](#)

1. When removing GBON [stations/platforms](#) from their networks, Members must ensure that the integrity and quality of GBON are maintained.

2. [Assignment and removal of the stations as described here do not apply to the surface marine stations/platforms.](#)

To facilitate the [GBON assignment and monitoring](#) process, Members are urged to undertake the following actions:

- (a) Ensure that a national focal point (NFP) for OSCAR/Surface is nominated and has the authority to [assign](#) GBON stations (see the [list of designated national focal points](#)).
- (b) Regularly conduct a national gap analysis against GBON requirements (see guidelines and template in section 11.4 on the Management of GBON).
- (c) Set and update their national targets for GBON and their National GBON Contribution Plan (see guidelines in section 11.5.3).

11.3.2 Removal of GBON affiliation from GBON [land](#) stations

Members may wish to remove GBON affiliation from GBON [land](#) stations for the following reasons: the station is no longer operational; the station was moved to another location and assigned a different WIGOS Station Identifier; the National Meteorological and Hydrological Services (NMHSs) or partner organization operating the station [has](#) no longer capacity to operate the station according to GBON requirements; the station duplicates other GBON stations, and so forth. In such cases, the stations are not removed from OSCAR/Surface, and their affiliation to GBON is not deleted: the OSCAR/Surface NFP must only indicate the date at which GBON affiliation stops in [OSCAR/Surface](#)

11.4 GBON COMPLIANCE

The definition of GBON compliance includes two parts: (a) Station-level compliance, and (b) Member-level compliance.

(a) Station-level compliance

This is achieved when a given station reports the required measurements, at the required temporal frequency, with the required reporting quality.

[Note: For marine stations/platforms, compliance is considered for the Member operator of an instrument making a GBON measurement, which may differ from the station/platform owner.](#)

(b) Member-level compliance

This is achieved when a given Member is operating a sufficient number of compliant GBON stations to satisfy the horizontal density requirements.

All GBON stations must be registered in OSCAR/Surface and include the network affiliation to GBON.

11.4.1 General considerations

11.4.1.1 Network density/coverage

Stations are assigned to a network which by design delivers the required density/horizontal coverage. Assessing density/horizontal coverage compliance through regular monitoring of stations reporting would be very complex. Therefore the current approach is to assign a number of stations to each State/Territory, which might include some redundancy, and then to proceed to an assessment of whether the number of compliant stations is equal to or greater than the number required.

11.4.1.2 Availability

Currently, the primary performance measure for assessing WMO observational compliance is based on data availability with the following generally accepted practices:

- Most WMO networks are monitored by stations reporting to an international data centre (that is, monitoring of reports received rather than observations made);
- Daily/weekly/monthly compliance monitoring tends to relate to the total number of reports for the period, rather than specifically to the temporal requirements;
- Most monitoring only assesses whether a report has been received or not, rather than assessing the content of the report;
- The WDQMS web tool uses statistics generated by the WIGOS monitoring centres (global NWP centres) and thus is able to assess against the different variables within the reports;
- Not all stations will necessarily report all the GBON mandatory variables.

The GBON upper-air requirements include also criteria on vertical range (burst height and resolution) which are not always able to be assessed in availability statistics.

11.4.1.3 Timeliness

All reports must be sent in near-real time over WIS. For example, if data are not received by the NWP centres by a certain time, they cannot be used. At a national level, and for some regional activities (such as EUMETNET), the timeliness has been agreed primarily to align with the NWP assimilation runs and the cut-off to use the measurements.

In future, WIS 2.0 will attribute a “time of receipt” to received reports, which will allow the timeliness to be calculated by comparing the time of receipt with the time of the observations. Once implemented, this will be considered in a future upgrade of the WDQMS web tool.

Regardless of how delayed a report is, there are some applications (namely, reanalysis and climate monitoring) which can still make use of the data. However, some of the data routing processes have a fixed time cut-off (such as > 24 hours) beyond which the report is automatically rejected.

11.4.1.4 Quality

If reported data are not of sufficient quality than the NWP systems will reject the data. In addition, if sufficient metadata are not recorded in the OSCAR/Surface database then this will directly impact on the quality monitoring of GBON.

Most reports of surface (land and marine) and upper-air (land and marine) stations contain no information about the quality of the measurements. Often, the operational processes and instrumentation used have an implied quality, which has been assessed through intercomparisons and test campaigns.

Most operational quality monitoring of NWP systems is undertaken as a quality evaluation process by comparing the measurements against a background field (that is, NWP model) and computing statistics of Observation – First Guess (OB-FG) field or Observation – Analysis (OB-AN) field.

The NWP assimilation also has a rejection process so as to prevent gross errors from negatively impacting the quality of the model products. Although the rejection criteria are often much more relaxed than the “threshold” limits in the WMO RRR, they can be useful in identifying stations/platforms with gross errors.

11.4.1.5 Format

According to the *Manual on the WIGOS*, section 2.4.4.1, Members shall report and make available observations in real time through the WIS in the standard formats specified in the *Manual on Codes* (WMO-No. 306), Volumes I.2 and I.3., such as the Binary Universal Form for the Representation of meteorological data (BUFR). For example, minimum 100 m vertical resolution of the upper-air measurements requires that the measurements are taken every 20 s, which can only be achieved through the complete BUFR code.

11.4.2 Station-level compliance monitoring

11.4.2.1 Station-level compliance criteria

The compliance criteria to be met for each GBON surface land and marine station/platform are presented in Table 11.2, while those for GBON upper-air land and marine stations are shown in Table 11.3. The criteria are applicable for each measured variable defined in section 11.2.1.

Table 11.2. Compliance criteria for GBON surface land and marine meteorological observing station/platform

Mark	Name	Description	Criteria
S _{SL} 1 ^a	Monthly availability (%)	No. of received monthly reports ^{b/} (Days per month x 24 ^c)	≥ 80%
S _{SL} 2	Timeliness (%)	No. of late reports ^{d/} (Days per month x 24)	< 5%
S _{SL} 3	Monthly quality (%)	No. of rejected monthly reports ^{e/} (Days per month x 24)	< 5%

Notes:

a S = number of stations, SL = surface land

b Monthly aggregation of observed variables from surface observation reports, received by at least one of the NWP centres monitored by WQMS web tool

c If a station is manually operated but is not operational 24 hours per day, this number can be reduced to the operational hours (hourly reporting, that is 0800–1700 = 10 reports) as recorded in OSCAR/Surface. This needs to be registered as an exception to GBON regulations.

d Monthly aggregation of reports that missed the time cut-off from NWP centres/WIS

- e Monthly aggregation of rejected reports from NWP centres. Could also be gross errors or outside of OB-FG threshold.

Table 11.3. Compliance criteria for GBON upper-air land and marine observing station/platform

Mark	Name	Description	Criteria
S _{UA} 1 ^a	Monthly availability (%)	No. of received monthly profile (to 30hPa) reports ^b / (Days per month x 24 ^c)	≥ 80%
S _{UA} 2	Vertical resolution ^d	Vertical resolution is at least 100 m	Yes
S _{UA} 3	Timeliness (%)	No. of late reports ^e / (Days per month x 24)	< 5%
S _{UA} 4	Monthly quality (%)	No. of rejected monthly reports ^f / (Days per month x 24)	< 5%

Notes:

- a S = number of stations, UA = upper-air
- b Monthly aggregation of observed variables from upper-air observation reports, received by at least two of the NWP centres monitored by WDQMS web tool
- c If a radiosonde station is only able to undertake one sounding per day, this number can be reduced to the scheduled reporting as recorded in OSCAR/Surface. This needs to be registered as an exception to GBON regulations.
- d For high-resolution data (BUFR) received, confirmed by at least one of the NWP centres monitored by WDQMS web tool
- e Monthly aggregation of reports that missed the time cut-off from NWP centres/WIS
- f Monthly aggregation of rejected reports from NWP centres. Could also be gross errors or outside of OB-FG threshold.

11.4.2.2 GBON station compliance assessment

At present, station compliance is assessed using the criteria outlined in Tables 11.2 and 11.3, applicable only to surface and upper-air land stations.

To enable compliance assessment, a GBON station must be registered in OSCAR/Surface and include the network affiliation to GBON. If the station does not meet this requirement, it will be assessed as non-compliant.

A surface land observing station/platform is found to be GBON compliant if all three criteria (SSL_1_--SSL_3) from Table 11.2 are met, for at least the measurement of atmospheric pressure.

A marine meteorological observing station/platform is found as GBON compliant if all three criteria (SSL_1 – SSL_3) from Table 11.2 are met for at least the measurement of sea level pressure.

An upper-air land observing station/platform station is found to be GBON compliant if all four criteria (SUA_1_--SUA_4) from Table 11.3 are met, for at least the measurement of air temperature.

11.4.3 Member-level compliance monitoring

11.4.3.1 Member-level compliance criteria

The compliance criteria to be met on the Member level compare, on the one hand, the number of the Member's stations that meet station compliance criteria described in section 11.4.2.1

with the number of stations estimated by the GBON global gap analysis (GGGA), on the other hand. The criteria are as follow:

M1: For surface land GBON compliant stations

The number of the Member's surface-land GBON compliant stations (S) is greater than, or equal to, the required number of surface-land GBON stations (RS) from GGGA:

$$S \geq RS$$

M2: For upper-air land GBON compliant stations

The number of the Member's upper-air land GBON compliant stations (U) is greater than, or equal to, the required number of upper-air land GBON stations from (RU) from GGGA:

$$U \geq RU$$

M3: For surface marine meteorological GBON compliant stations (M), in Exclusive Economic Zones

The number of Member's surface marine GBON compliant stations (M)* in Exclusive Economic Zones, is greater than, or equal to, the required number of surface marine GBON stations (RM) from GGGA:

$$M \geq R$$

* This number includes all contributions from all Members having stations/platforms within the EEZ of the Member in question

11.4.3.2 GBON Member compliance assessment

GBON Member compliance is assessed against the criteria M1 and M2, and M3, if a Member has a coastline, as outlined in section 11.4.3.1 on a monthly basis.

A Member without a coastline is found to be GBON compliant only if both, M1 and M2, criteria are met.

A member with a coastline is found to be GBON compliant only if all three criteria are met.

Note: Under certain circumstances, for example when a Member's territory is relatively small or of an irregular shape, some GBON compliant stations from the neighbouring Member(s) can be included in the Member's compliance assessment. In such circumstances, the Member concerned must provide written proof that the neighbouring Member(s) agrees to include its stations in the GBON assessment of the Member concerned, must and report this to the Secretariat, as described in section 11.4.5.

11.4.4 Compliance status and reporting

GBON compliance at the station and Member levels will be routinely assessed and the results made available using tools such as the WDQMS web tool. Station-level compliance results, aggregated on a monthly basis, will be automatically produced and made available online from the WDQMS web tool. Member-level assessments will be undertaken and provided on a quarterly basis by the INFCOM Standing Committee on Earth Observing Systems and Monitoring Networks (SC-ON) assisted by the Secretariat, on the basis of data provided by the WDQMS web tool. It is recommended that Members review these quarterly assessments and take action if needed. The Regional WIGOS Centres (RWCs), and the OceanOPS as appropriate, will also assist in this regard by alerting Members to non-compliance issues and discovered incidents. An annual compilation of national GBON assessment reports based on the

Members' quarterly assessments, taking into account Members' feedback if available, will be produced by SC-ON, with the assistance of the Secretariat, and published.

Members are invited to be aware of their compliance status and to undertake their own compliance monitoring, with the goal of evolving their observing networks towards full GBON compliance, if this is not already the case.

11.4.5 Exemption under Article 9 of the WMO Convention

Compliance status of Members invoking Article 9 of the WMO Convention

Article 9(b) of the WMO Convention published in the *Basic Documents No. 1* (WMO-No. 15) states that "If ... any Member finds it impracticable to give effect to some requirement in a technical resolution adopted by Congress, such Member shall inform the Secretary-General of the Organization whether its inability to give effect to it is provisional or final, and state its reasons therefor".

The *Technical Regulations* (WMO-No. 49), Volume I, General Provisions, paragraph 6 states:

In accordance with the above definitions, Members shall do their utmost to implement the standard practices and procedures. In accordance with Article 9(b) of the Convention and in conformity with Regulation 101 of the General Regulations, Members shall formally notify the Secretary-General, in writing, of their intention to apply the standard practices and procedures of the Technical Regulations, except those for which they have lodged a specific deviation. Members shall also inform the Secretary-General, at least three months in advance, of any change in the degree of their implementation of a standard practice or procedure as previously notified and the effective date of the change.

Accordingly, the following conditions, criteria and implications on compliance status of a Member invoking Article 9(b) concerning their contribution to GBON are as follows:

- Concerning the horizontal resolution requirement, a Member invoking Article 9(b) concerning its commitment to GBON should clearly indicate: the reasons; the part of its territory for which it is seeking an exemption from meeting GBON requirements; its level of commitment to meeting the GBON horizontal resolution requirement for the rest of its territory; the period during which it believes such part of its territory would be exempted; and whether it has any plan to improve the situation;
- Concerning the temporal resolution requirement, a Member invoking Article 9(b) concerning its commitment to GBON should clearly indicate: the subset of its GBON observing stations or the part of its territory that will not be meeting the temporal resolution requirements; the reasons why the requirement cannot be met; the period during which it believes such subset of stations or the part of its territory would be exempted; and whether it has any plan to improve the situation.

An independent committee of experts designated by the INFCOM president in consultation with the INFCOM management group will coordinate with the Member to review the basis of the Article (9b) exemption, consider if there are any potential ways to resolve the issue such as existing contributing stations near just outside the Member's border, and factor that review into determining if a Member submitting exemption under Article 9(b) should be regarded as GBON compliant on the basis of the following criteria:

- (a) A substantial part of the Member's territory is compliant with GBON horizontal requirements (for small Members, if the horizontal requirement for GBON is being met thanks to the GBON commitment of a neighbouring Member(s), the Member may still be regarded as GBON compliant if it is committing at least one observing station to GBON);

- (b) A substantial number of the GBON stations committed by the Member comply with GBON temporal resolution requirements.

If the independent committee of experts considers that the Member is GBON compliant, such status will be reflected in the overall compliance status of all Members. On the contrary, the Member will be informed about its non-compliance status by the Secretary-General, and will be urged to take steps to become compliant. The INFCOM president will inform the Executive Council about the independent committee's decision.

11.5 MANAGEMENT OF GBON

11.5.1 Roles and responsibilities

Table 11.4 clarifies the roles and responsibilities of the main stakeholders involved in the process for establishing the initial composition of GBON. Responsibilities of national focal points are detailed in the present Guide, Chapter 6, Annex 1.

Table 11.4. Roles and responsibilities of the main stakeholders in establishing the initial composition (January 2023) of GBON

Stakeholder	Role
Members	- Nominate WIGOS, <u>OSCAR/Surface</u> and WDQMS national focal points (NFPs) and brief them on their role in support of GBON implementation; make sure NFPs will receive appropriate support from their management to undertake their role. - Consider GBON requirements; identify opportunities for committing GBON stations and filling identified gaps; implement GBON requirements; take action as needed for complying with them. - Review GBON compliance assessment reports and take action as needed. <u>Assign</u> additional GBON stations, including, for example, existing stations not currently reporting internationally or stations from partner organizations for which a Memorandum of Understanding (MoU) to commit the stations to GBON could be negotiated and established at the national level. - Least developed and small island developing States (SIDS) to apply for SOFF funding. - Other developing countries to make use of capacity-development opportunities, including SOFF technical support where applicable.
WIGOS monitoring centres (global NWP centres contributing to WDQMS)	Assimilate GBON data and provide the information needed for the WDQMS web tool on the GBON compliance monitoring.
WIGOS national focal points	- Contribute to the design of GBON and identify the existing or new GBON stations to be committed by their <u>country/territory</u>, and promote or coordinate the necessary actions nationally to reach such commitment. - Perform a National GBON Gap Analysis and inform the WMO Secretariat of their <u>country's/territory's</u> capabilities and any possible non-achievable requirements. - Negotiate with partner organizations and encourage non-NMHS observing stations to be made available when they meet GBON requirements.
OSCAR/Surface national focal points	Make sure that candidate GBON stations' WIGOS metadata are recorded and kept updated in OSCAR/Surface.
WDQMS national focal points	Check and monitor compliance of GBON stations nationally, using the WDQMS web tool, and address any incident that may have been reported by the Regional WIGOS Centre.
Regional WIGOS Centres (RWCs)	Monitor compliance of GBON observing stations with GBON requirements, and alert Members via their WDQMS NFPs about identified incidents.

Regional associations/ working groups on infrastructure	Promote regional cooperation and exchange of data across political boundaries; share benefits, share space, propose prioritization mechanism(s) for such cooperation, e.g. in support of disaster risk reduction; facilitate exchange of GBON data using existing global and regional infrastructure (e.g. WIS centres, WIS 2.0 in a box).
WMO Secretariat	- Provide technical support to INFCOM teams for the design of GBON composition and GBON compliance monitoring, including: - Liaise with WIGOS NFPs to obtain information on Members' capabilities and the candidate observing stations they wish to commit to GBON. - Perform global gap analysis and make proposals on the assignment of GBON stations. - Propose updates to guidance material on GBON as needed. - Consider how to make the best use of WIGOS tools (WDQMS, OSCAR/Surface), and assist INFCOM teams in determining how these tools should evolve or be used for GBON. - Assist SC-ON with station- and Member-level assessments and the production of corresponding reports. - Assist INFCOM teams to produce Member-level assessment reports (quarterly and annually), as well as other relevant related tasks.
SOFF Secretariat	- Coordinate the implementation of SOFF according to the SOFF Secretariat Terms of Reference. - Provide support to Members concerning the understanding of SOFF operational elements in support of GBON implementation to fill the gaps. - Collaborate with the WMO Secretariat and INFCOM teams to develop and provide specific guidance and training for SOFF peer advisors. - Collaborate with the WMO Secretariat and INFCOM teams in identifying GBON Member opportunities for SOFF programming decision-making. - Collaborate with the WMO Secretariat and INFCOM teams in establishing the functions of WMO as SOFF Technical Authority. - Collaborate with the WMO Secretariat and INFCOM teams in developing specific WDQMS reports, and OSCAR/Surface features for SOFF.
INFCOM president	Designates and independent committee of experts, in consultation with the INFCOM management group, to review Members' submissions for exemptions under Article 9(b), and determine any impact on GBON requirements compliance, Informs the Executive Council about the independent committee's findings.
INFCOM teams/SC-ON	- Produce Member-level assessment reports (quarterly and annually) with assistance from the WMO Secretariat. - Develop technical guidelines, processes and procedures needed to ensure expedient and efficient implementation of GBON, and to prepare for effective performance and compliance monitoring of GBON.

11.5.2 GBON National Gap Analysis

To implement GBON at a national level, Members are encouraged to complete the GBON National Gap Analysis in order to understand the existing gap in the required observing networks and to identify their national contributions to the composition of GBON for filling the identified gaps.

The gap analysis is the starting phase for implementing the GBON regulations. The objective of the analysis is to define the gap between the GBON requirements and the existing surface, upper-air and marine observing networks. In other words, it serves as the basis for identifying the number of observing stations that need to be installed or improved in order to become compliant with the requirements of the GBON regulations.

The guidance outlined in 11.5.2.1 provides a step-by-step process for defining the GBON National Gap Analysis for GBON requirements. The results serve to help Members to assess

whether their current network is meeting the requirements, to plan actions to upgrade the observing networks as necessary and to assign the first stations to the GBON network.

The completed GBON National Gap Analysis serves as the objective and quantitative basis for the preparation of the National GBON Contribution Plan (detailed in 11.5.3), which considers the best approaches and activities for complying with the GBON regulations. Section 11.2 provides a summary of the GBON regulations.

11.5.2.1 Gap analysis steps

The global gap analysis provides a quantitative estimate of the number of surface and upper-air observing stations over land per Member that are needed in order to meet the GBON requirements. The WMO Secretariat completes the global analysis of which stations are internationally sharing the data, based on the information available through the WDQMS web tool. This global gap analysis serves as a baseline for the national assessment of existing observation networks against the target number of stations.

A Template for the GBON National Gap Analysis report is available on the [References to GBON material](#) web page.

Step 1 – Analysis of the GBON horizontal resolution requirements

In this step, the Member-specific GBON horizontal resolution requirements are analysed based on the global GBON gap analysis performed by the WMO Secretariat and the final adjustment by the Member. While the global gap analysis is a simplified analysis, the number of target GBON stations should be reviewed and adjustments made as needed by every Member. The global gap analysis does not include a full investigation of the Exclusive Economic Zone (EEZ), and therefore, no target number for marine observing stations is given. For Members with an EEZ, the initial GBON target needs to be assessed in terms of the surface marine observing network. Those Members whose territories are split across separate locations should assess the GBON requirements for such territories individually.

Elements in step 1 (Table 11.5):

- (a) GBON horizontal resolution requirements: The GBON regulations, as published in the *Manual on the WIGOS*;
- (b) GBON target: The number of surface and upper-air stations required, based on the GBON global gap analysis completed by the WMO Secretariat and adjusted by the Member as necessary;
- (c) Reporting: the number of surface, upper-air and marine stations reporting internationally to WIS;
- (d) Gap improve: The number of surface, upper-air and marine stations that could a priori be improved to meet GBON requirements, for example, by increasing the number of shared observations (the default position being the global gap analysis);
- (e) Gap new: The number of new surface, upper-air and marine stations that need to be established and installed (the default position being the global gap analysis);
- (f) Gap total: The total number of stations that need to be either improved or newly installed (the default position being the global gap analysis).

Table 11.5. GBON network requirements for horizontal resolution

<i>GBON horizontal resolution requirements</i>	<i>GBON target</i>	<i>Reporting</i>	<i>GAP improve</i>	<i>GAP new</i>	<i>GAP total</i>
Surface stations standard density, 200 km					
Surface stations, high density, 100 km					
Upper-air stations over land, standard density, 500 km					
Upper-air stations over land, high density, 200 km					
Upper-air stations over marine, 1 000 km					
Surface marine stations, 500 km					

Caveats to the global gap analysis results:

- (a) The reporting threshold for GBON upper-air stations over land was one daily sounding, noting that the GBON requirement is two soundings per day;
- (b) For SIDS, the EEZ area has been added to the total surface area, which is the basis for the target number of stations;
- (c) The surface area was computed based on a geographic information system model and may slightly deviate from official records.

Step 2 – Analysis of existing GBON stations and their status against GBON requirements

In step 2 (Table 11.6), the Member assesses the existing national observing networks and stations. This includes stations operated by the NMHS and other governmental agencies or the private sector which could potentially be included in the national GBON network. Stations' operational status is assessed, along with the variables reported and maps provided to indicate the station distribution.

First, the assessment is done for observing networks operated by NMHS and the by third party operators at a network level. The networks are evaluated based on the mandatory GBON requirements as described in the left column of Table 11.1 in section 11.2.1.

The elements to be analysed in step 2 are:

- (a) NMHS network: The number of stations managed by the NMHS. The surface, upper-air and marine stations are assessed and categorized as either "reporting" or to "improve";

Key:

S: Surface; UA: Upper-air; M: Marine; Owner: Owner of the station (name of NMHS or third party); SLP: Atmospheric pressure; T: Temperature; H: Humidity; W: Wind; P: Precipitation; SD: Snow depth; Reporting cycle: Number of observation reports exchanged internationally per day (0–24); GBON compliant: whether the station is compliant (Yes/No)

Step 3 – GBON gap analysis results

The results of steps 1 and 2 are summarized to Table 11.8. The table is to be completed with: the number of stations required by the GBON regulations (GBON target); the number of existing stations compliant with the GBON requirements; and the new and to improve GBON stations needed (new and to improve) for surface, upper-air and marine networks.

A map of existing stations is developed with the location of gaps indicated in circles of a 200 km radius (surface) and 500 km radius (upper-air and marine) around the existing stations.

Table 11.8 Results of the GBON National Gap Analysis

GBON requirements	GBON target	Stations compliant with GBON	Stations needed against GBON requirements	
			New	To improve
Surface station standard density, 200 km				
Surface station high density, 100 km				
Upper-air stations over land, standard density, 500 km				
Upper-air stations over land, high density, 200 km				
Upper-air stations over marine, 1 000 km				
Surface marine stations, 500 km				

Note: Members should include in the analysis, along with the above information, maps of existing surface, upper-air and marine networks with gaps indicated.

A list of surface, upper-air and marine stations which are compliant with the GBON regulations and assigned to GBON is summarized in Table 11.9.

Table 11.9. Surface, upper-air and marine stations to be assigned to GBON.

<i>Station name</i>	<i>Station type (S/UA/M)</i>

The Template for the GBON National Gap Analysis report is available on the [References to GBON material](#) web page.

11.5.2.2 Further considerations for GBON implementation and operations

The gap analysis does not investigate the reasons behind the gap. Based on the results from the GBON National Gap Analysis, the detailed National GBON Contribution Plan will be developed where the national GBON target will be defined and which will address corresponding actions to fully comply with the GBON regulations.

Each Member must assign, at a minimum, the required number of surface, upper-air and marine stations as their contribution to GBON. Those stations which already comply with the GBON regulations should be considered as an initial subset of stations, and assigned to GBON by registering the stations in OSCAR/Surface and addressing the metadata requirements.

If the national observing network does not meet a certain GBON requirement, and for some reason, actions to comply with the requirement are not going to be taken, the reason must be reported to the WMO Secretary-General by seeking an exemption in accordance with Article 9 of the WMO Convention (see section 11.4.5). As an example, an exemption might be sought if a GBON requirement is not applicable in the territory of the Member because the requirement is not technologically possible or economically viable.

The GBON regulations are a comprehensive set of provisions which not only drive a certain density for the observation network, but also require a long-term commitment to GBON operations, with expectations for high-quality and timely observational data to be made available for all WMO Members. Therefore, operational observation network management practices should be reviewed, and capacity-development activities considered as part of the National GBON Contribution Plan for guaranteeing the sustainable operations of GBON.

A Member can adjust and extend the templates provided in the present Guide based on the national operational practices, as needed. The WMO Secretariat and INFCOM are available for responding to questions, providing support and sharing best practices in every phase of GBON implementation.

11.5.2.3 Environmental sustainability considerations

INFCOM has requested, through Resolution 4 (INFCOM-1) ([INFCOM: Abridged Final Report of the First Session](#) (WMO-No. 1251)), that the future development and implementation of GBON addresses the environmental impact of observing systems and methods.

Members are encouraged to consider environmental sustainability as foundational in the design and evolution of networks to achieve GBON horizontal and temporal resolution requirements. Pragmatic and sustainable approaches to achieving GBON observation requirements are to be considered along the full weather and climate data value chain, including:

- The development and use of specifications that consider environmental sustainability for procurement of measurement instrument equipment to meet the GBON requirements;
- Integration of sustainability considerations into regulatory compliance for the management of operations of GBON compliant weather and climate stations, including with regards to installation, calibration, and maintenance;
- Careful material selection for the development, shipping and day-to-day operations of GBON compliant stations, with a focus on the development and use of reusable instruments and sustainable methods of observation (for example, elimination of single-use plastics).

Recommendations related to environmental sustainability will be considered for future amendments to WIGOS regulatory material and GBON guidance, with the long-term goal of advancing more environmentally friendly weather and climate observing systems, technologies and practices. These recommendations will evolve and become more detailed over time as new information is gathered, analysed and translated into requirements.

11.5.3 National GBON Contribution Plan

The National GBON Contribution Plan (the Plan) constitutes the basis for Member plans and efforts to become GBON compliant. The National GBON Gap Analysis, completed prior to the development of this Plan, serves as an analytical basis to develop the Plan. Based on the results from the analysis, the Member sets a GBON target, as well as the activities required to achieve that target, in the Plan.

The objective of the National GBON Contribution Plan is to identify the observing infrastructure, human and institutional capacity needed to achieve a progressive target towards GBON compliance and a sustainable level of operations and maintenance of the national observing network.

The guidance is structured into five modules that constitute the building blocks of the Plan. These five modules are undertaken in parallel so that the final plan is consistent with each output of the modules.

11.5.3.1 Development of the National GBON Contribution Plan

The guidance outlined in the present chapter is structured across five modules that cover different areas required for the implementation of GBON. It provides, for each module, a list of activities and expected outputs which should be addressed in terms of the current facilities and capabilities in the national observing infrastructure.

The modules of the Plan are:

- **Module 1. National GBON target:** National target towards GBON compliance that considers the Member's circumstances.
- **Module 2. Institutional capacity development:** Institutional capabilities required to operate, maintain and manage the GBON observing network.
- **Module 3. Infrastructure development:** Observing network infrastructure required to achieve the national target and compliance with the GBON regulations.

- **Module 4. Human capacity development:** Human capacity needed to manage, operate and maintain the GBON observing network.
- **Module 5. Risk management:** Observing network operational risks and required mitigation measures.

Each module lists recommended activities and their expected deliverables. The key activities and best practices should align with the national strategy for observing networks, as relevant for the Member. Existing operational systems, processes and practices be utilized where appropriate. The preliminary timeline and financial implications should be considered as a part of the Plan for each module.

The modules provide a standard approach which can be adjusted based on the national needs and expectations.

The activities are planned to meet the national target toward GBON compliance in each module. The Plan should be reviewed regularly with an aim to advance the activities defined for achieving full GBON compliance in a sustainable manner.

Module 1: National GBON target

Based on the results from the National GBON Gap Analysis, the Member sets a national GBON target towards progressive GBON compliance. The target should be progressive so that the elements of the target are increased periodically, aiming for the Member to achieve full GBON compliance in a reasonable period of time. The target reflects the level of ambition of the Members, taking into account the gradual process, national circumstances and the feasibility of implementing the activities to achieve such a target. Activities and outputs for Module 1 are summarized in Table 11.10.

Table 11.10. Activities and outputs to be undertaken and delivered for Module 1

<i>Item</i>	<i>Activity</i>	<i>Outputs</i>	<i>Relevant guidance material</i>
1.1	Conduct the National GBON Gap Analysis	Results of the gap analysis as the baseline	See 11.5.2 above
1.2	Establish the national target towards GBON compliance	Based on the gap analysis, set a target in terms of number of new/improved stations and percentage of reports exchanged	

Module 2: Institutional capacity development

In this module, the Member's institutional capabilities, including NMHS partnerships with other national governmental and private partners and with subregional and regional GBON stakeholders, and the Member's financial capabilities, are assessed in terms of their capacity for strengthening the resources and activities required to operate and maintain the observing network.

This module also includes an assessment of the Member's existing strategies for developing and improving observing networks and an assessment of the national legislation in terms of GBON regulations. Activities and outputs for Module 2 are summarized in Table 11.11.

Table 11.11. Activities and outputs to be undertaken and delivered for Module 2

<i>Item</i>	<i>Activity</i>	<i>Outputs</i>	<i>Relevant guidance material</i>
2.1	Assess governmental partner organizations for supporting GBON operations	1. Assessment of governmental partners and stakeholders and their potential contribution to GBON network operations: (a) Existing partners and relationships (b) Potential new partners and collaborators and their role	<i>Guide to the WMO Integrated Global Observing System</i> (WMO-No. 1165), Chapter 6
2.2	Assess private sector entities providing meteorological observations in the Member's territory and potential partnerships for supporting GBON operations	1. Assessment of private sector operators providing meteorological observations and data services in the Member's territory 2. Business model for public-private collaboration for the implementation of the Plan, including identified potential private sector operators for the collaboration	<i>Guidelines for Public-Private Engagement</i> (WMO-No. 1258)
2.3	Assess potential subregional contributors for supporting GBON operations	1. Identified neighbouring countries and regional organizations of relevance for potential subregional collaboration 2. Plan for potential optimization of the observing network through subregional network design and other optimization arrangements for the implementation of the Plan	
2.4	Assess the Member's financial model	1. Assessment of current funding sources, budget allocations and financial status related to operations of the national observing infrastructure 2. Sustainable financial management plan to operate the GBON infrastructure in line with the proposed public-private business model, in the form of a: (a) Financial plan for operating the modernized infrastructure (b) Business plan over 5 to 10 years supporting an increase in financing for operations of GBON network	
2.5	Assess existing national strategies and projects for developing and improving observing networks	1. Review of the national strategies for developing and improving observing networks 2. Plan for harmonizing the activities defined in the general strategy of Member observation services along with this Plan 3. Review of existing or planned hydrometeorological development projects related to GBON and consideration of any action for avoiding duplications	
2.6	Review the national legislation in terms of GBON regulations	1. Review of the legislation in terms of the national responsibility for measuring and providing weather observations related to GBON	

<i>Item</i>	<i>Activity</i>	<i>Outputs</i>	<i>Relevant guidance material</i>
		2. Review of the legislation related to procurement, importation and customs processes to enable smooth implementation of the Plan 3. Recommendation on how to address any constraints imposed by the national legislation needed to implement GBON	

Module 3: Infrastructure development

Based on the gaps identified in the National GBON Gap Analysis, the Member develops a detailed plan for all components of the observing infrastructure and investments needed to meet the national target toward GBON compliance. The plan should follow the national strategy for the development and management of observing networks so that the components of the modernized infrastructure and operation practices are harmonized with the existing network.

The *Manual on the WIGOS*, the *Manual on Codes* (WMO-No. 306), Volumes I.1, I.2 and I.3, the *Manual on the WMO Information System* (WMO-No. 1060) and the *Manual on the Global Telecommunication System* (WMO-No. 386) are the key WMO Technical Regulations to be followed for the establishment of a network, and for reporting and making observations and metadata internationally available through the WIS and WMO OSCAR/Surface metadata management system.

Activities and outputs for the Module 3 are summarized in Table 11.12.

Table 11.12. Activities and outputs to be undertaken and delivered for Module 3

<i>Item</i>	<i>Activity</i>	<i>Outputs</i>	<i>Relevant guidance material</i>
3.1	Design the surface, upper-air and marine observing networks and observational practices, including networks operated by third parties	1. Based on the National GBON Gap Analysis and the National GBON Target, a completed, harmonized observing network design, including: (a) A map of observing network design and a list of new/rehabilitated GBON stations (b) Siting and instrumentation of new and improved stations, and a list of observation instruments and systems per site (c) Plan for the investments and activities needed for the installation of any new stations and the improvement of existing stations (d) Articulation of environmental sustainability considerations in network design and implementation (new	<i>Manual on the WIGOS</i> <i>Guide to the WMO Integrated Global Observing System</i> (WMO-No. 1165) <i>Guide to Instruments and Methods of Observation</i> (WMO-No. 8) Generic Automatic Weather Station (AWS) Tender Specifications (WMO Instruments and Observing Methods Report No. 136)

<i>Item</i>	<i>Activity</i>	<i>Outputs</i>	<i>Relevant guidance material</i>
		stations, instruments, etc.) 2. Observational practices defined per network 3. Preliminary maintenance plan for existing and improved/new stations, including calibration practices 4. Technical specifications for new instruments and observing systems for the procurement process, including sustainability considerations	
3.2	Design the ICT infrastructure and services	1. ICT infrastructure and services design for solutions on data transmission from an observing station to the national real-time data management system and to GTS and WIS 2.0 including: (a) Detailed description of the ICT infrastructure and services design (b) Technical specifications for the data collection system from observing station to collection point (c) Technical specifications of the data services (compatible with the requirements of WIS 2.0) (d) Detailed description of the measures to ensure resilience and continuity of the full data-processing chain	<i>Manual on Codes</i> (WMO-No. 306), Volumes I.1, I.2 and I.3 <i>Manual on the WIGOS</i> <i>Manual on the Global Telecommunication System</i> (WMO-No. 386) WIS 2.0 requirements http://docs.wis2box.wis.wmo.int
3.3	Design the data management system	1. Requirements for a data management system that aims to provide access to data used by operational applications on a real-time basis, and that has the capability to deliver data to a Climate Data Management System (CDMS) for long-term archiving purposes. The system should provide: (a) Short-term data storage and access through the services and protocols required by applications for national and international operational activities (b) Exchange of data to and from WIS/GTS, WIS 2.0 and other national or international sources required for operational activities	<i>Manual on the WIGOS</i> <i>Manual on Codes</i> (WMO-No. 306), Volumes I.1, I.2 and I.3 <i>Manual on the WMO Information System</i> (WMO-No. 1060), <i>Manual on the Global Telecommunication System</i> (WMO-No. 386) Climate Data Management System Specifications (WMO-No. 1131)

<i>Item</i>	<i>Activity</i>	<i>Outputs</i>	<i>Relevant guidance material</i>
		(c) Data delivery to the national CDMS (d) Discovery and descriptive metadata management (e) Monitoring of data, processing and services	

Module 4: Human capacity development

Human capacity development is the backbone of GBON implementation and critical to ensure the sustainability of the observing network. Modernized observation infrastructure requires increased knowledge and skills of the staff, to overcome future challenges in the operations of the network.

The Member assesses human capacity gaps and designs capacity-development activities needed to close those gaps. The capacity-development activities should target technical staff to maintain the modernized observation infrastructure, and senior management to manage long-term strategic implementation of the Plan.

The type of human expertise and training depends on the infrastructure design chosen and the Member's human capacity gaps. The emphasis should be on maintaining essential capacity related to the generation and exchange of observations. In the case of opting for private sector partners, it is important to ensure that the Member has the expertise and capacity to engage in, monitor and manage the contractual relationships and control the services purchased. Activities and outputs for Module 4 are summarized in Table 11.13.

Table 11.13. Activities and outputs to be undertaken and delivered for Module 4

<i>Item</i>	<i>Activity</i>	<i>Outputs</i>	<i>Relevant guidance material</i>
4.1	Assess human capacity gaps	1. Inventory of staff skills, education levels and capacity gaps for technicians, experts and management	Guide to Competency (WMO-No. 1205) Guidelines for Trainers in Meteorological, Hydrological and Climate Services (WMO-No. 1114)
4.2	Design capacity-development activities for technical staff	1. A plan for the training activities and recruitments needed for technical staff in: (a) Instrument and station maintenance at site (b) Calibration and maintenance at the workshop (c) Network monitoring (d) ICT system operations	Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology (WMO-No. 1083)
4.3	Design capacity-development activities for senior management	1. A plan for the training activities and recruitments needed for management in: (a) Strategic and financial planning (b) Project management	Guidelines for Applying for a WMO Fellowship (WMO-No. 1104) A Compendium of Topics to Support Management Development in National Meteorological and Hydrological Services (ETR-No. 24)

Module 5. Risk management

Proactive risk management activity consists of trying to anticipate deviations from the Plan and implementing mitigation actions so that the objectives are reached despite the risks. Risks that materialize may prevent the infrastructure from satisfying the specified requirements, and

prevent the successful implementation and the sustainability of operations of the modernized observation infrastructure.

The Member should assess the most relevant and expected operational risks for the implementation of the Plan and define mitigation measures. For this, the risk and control matrix should include the following:

- Identified risks and their effects
- Risk category
- Likelihood and impact scoring with total impact
- Mitigation action
- Responsibility

Activities and outputs for Module 5 are summarized in Table 11.14.

Table 11.14. Activities and outputs to be undertaken and delivered for Module 5

<i>Activity item</i>	<i>Activity</i>	<i>Outputs</i>	<i>Relevant guidance material</i>
5.1	Assess the operational risks for the implementation of the Plan and define mitigation measures	1. A matrix to manage risks and proposed mitigation activities, including: (a) Identification of operational risks (b) Analysis of risks (c) Actions for mitigating the risks (d) Mechanism for monitoring and evaluating risks following implementation of mitigation actions	<i>Guide to the Implementation of Quality Management Systems for National Meteorological and Hydrological Services and Other Relevant Service Providers</i> (WMO-No. 1100)

The Template for the National GBON Contribution Plan Report is available on the [References to GBON material](#) web page.

11.6 REGULATIONS FOR REPORTING GBON PARAMETERS

11.6.1 Reporting of hourly observations

In accordance with the *Manual on the WIGOS*, section 3.2.2, GBON surface land observing stations and upper-air stations shall observe a minimum number of required variables. Reporting practices for these GBON required variables [are](#) specified in the *Manual on Codes* (WMO-No. 306), Volume I.2, Part C, e, Regulations for reporting GBON parameters.

11.6.2 Additional WIS guidance

Following Resolution 34 (EC-76) - Implementation Plan Update of the WMO Information System 2.0 ([Executive Council: Abridged Final Report of the Seventy-sixth Session](#) (WMO-No. 1314)), Members are requested to exchange GBON observations through GTS and WIS in accordance with the *Manual on the Global Telecommunication System* (WMO-No. 386) and the *Manual on the WMO Information System* (WMO-No. 1060), Volume I until WIS 2.0 becomes operational in 2024. Parallel dissemination of data through GTS and WIS 2.0 is recommended from the start of the pilot phase in 2023.

Further details are provided in the *Guide to the WMO Information System* (WMO-No. 1061).

Exchange of GBON observations through WIS 2.0 will be regulated by the *Manual on the WMO Information System* (WMO-No. 1060), Volume II.

11.7 GBON-specific metadata in Oscar/Surface [OSCAR/Surface](#) is the official source of information for WIGOS metadata from all surface-based stations/platforms, in accordance with the *Manual on the WIGOS* and with the *WIGOS Metadata Standard* (WMO-No. 1192). The repository serves to record and retain all current and historical WIGOS metadata.

[GBON stations are identified in OSCAR/Surface by linking a station with the GBON programme/network affiliation. GBON stations are displayed in OSCAR/Surface.](#)

[Guidance on how to assign the stations to GBON and search for them is available in the OSCAR/Surface User Manual](#) is available online, in six WMO languages.

The GBON module of the WDQMS web tool provides Members with timely feedback about the station-level performance in relation to the GBON provisions. The system is based on the GBON compliance criteria adopted by INFCOM. The GBON module of the WDQMS web tool also provides the quantitative data which contributes to the Member-level GBON compliance monitoring.

More information about the GBON module of the WDQMS web tool can be found in the online [WDQMS User Guide](#).

12. THE REGIONAL BASIC OBSERVING NETWORK

Note: In the present chapter, reference is made to the regional associations and their management groups, which rely on their working groups on infrastructure (RA/WG-I). However, for Antarctica, the corresponding bodies are the Executive Council and its Panel of Experts on Polar and High Mountain Observations Research and Services (EC-PHORS), which can rely in turn on the INFCOM Global Cryosphere Watch (GCW) Advisory Group (GCW-AG) for technical work. For ease of writing and understanding of the process described in the present chapter, for the Antarctica RBON design process, references to "regional associations" should therefore be interpreted as "Executive Council", to the "management group" as "EC-PHORS" and to "working group on Infrastructure" as "GCW-AG". See also Resolution 49 (Cg-18) on the Antarctic Observing Network.

The present chapter describes the design process of the Regional Basic Observing Network (RBON) by the regional associations.

12.1 COORDINATION OF THE DESIGN PROCESS, ROLES AND RESPONSIBILITIES

12.1.1 The Regional Association Working Group on Infrastructure

The Regional Association Working Group on Infrastructure (RA/WG-I) is responsible for applying and coordinating the design process for RBON in consultation with the Members of the region and the Points of Contact of the Rolling Review of Requirements (RRR) application areas. In doing so, it promotes regional cooperation and exchange of data across boundaries, shares benefits, shares resources, optimizes the deployment of observing stations geographically and proposes prioritization mechanism(s) for such cooperation, for example, in support of disaster risk reduction. It also helps facilitate the processing and exploitation of RBON data and the use of existing global and regional infrastructure (such as WMO Information System (WIS) centres).

To undertake and coordinate the design process, the RA/WG-I may wish to establish a task team on RBON design.

12.1.2 Members and other bodies

Members play a key role in the design of RBON since it is the Members that invest in and provide commitments to RBON. Annex 1 provides a summary of the role of Members and other bodies regarding the design of RBON. Such other bodies include: the Regional WMO Integrated Global Observing System (WIGOS) Centres (RWCs); regional associations and their presidents, management groups and RA/WG-I (or their established task team on RBON design); national focal points (NFPs) for WIGOS, [OSCAR/Surface](#) and the WIGOS Data Quality Monitoring System (WDQMS⁴⁷); and the Secretariat. In particular, the WIGOS NFPs nominated by Members will assist the RA/WG-I in its work and help assess the Members' capabilities and identify those existing and planned GBON stations that could be upgraded to meet RBON requirements.

Note: See Terms of Reference for the WIGOS NFPs in Annex 1 to Chapter 6 of the present Guide.

12.2 REQUIREMENTS, GAP ANALYSIS AND DESIGN OF RBON

12.2.1 Key regional weather, climate, water and other environmental challenges

The regional association, in consultation with its Members and key stakeholders, will select a small number of key regional weather, climate, water and other environmental challenges to be addressed in order to bring substantial socioeconomic benefits to the region through the use of RBON data.

Criteria for selecting the key regional challenges may include:

- (a) Likelihood of an event and the severity of its impact on society, or the substantial benefits brought to society by accurate forecasting of the event;
- (b) Commonality of the challenges across WMO application areas;
- (c) Substantial impact of the use of the RBON data on addressing the key regional challenges based on the results from impact studies.

The regional association may also wish to consider what impact studies to conduct at the regional level in order to better assess the impact of RBON data on the candidate key regional challenges.

The list of key regional challenges to be considered for RBON design is proposed by the RA/WG-I, following consultation with regional association Members and the key stakeholders and then decided by the president of the regional association in consultation with the management group. Examples of key regional weather, climate, water and other environmental challenges are provided in Annex 2.

For each key regional challenge, the regional association will identify the application areas that will substantially benefit from addressing the challenge, and the key variables to be observed for each application area (consideration will be given to the relative priorities of variables).

It is to be noted that the observational user requirements for Global Numerical Weather Prediction (GNWP) and climate data re-analysis at the breakthrough⁴⁸ level are already considered for the design of the GBON; these requirements are more stringent than the RBON

⁴⁷ <https://wdqms.wmo.int>

⁴⁸ The "breakthrough" is an intermediate level between "threshold" and "goal" which, if achieved, would result in a significant improvement for the particular application that registered this requirement. The "goal" is an ideal requirement above which further improvements are not necessary.

requirements, and only the key regional challenges not already addressed by GBON should be considered for RBON design.

12.2.2 Regional requirements

Once the key regional weather, climate, water and other environmental challenges and the WMO application areas are identified, the regional association may wish to define regional requirements for some top-level high-priority variables to be observed for these application areas. By default, the global requirements in [OSCAR/Requirements](#) are used. Regional requirements are proposed by the RA/WG-I, approved by the president of the regional association in consultation with the management group and then recorded in OSCAR/Requirements through the Rolling Review of Requirements (RRR) Points of Contact of the relevant application areas.

The RA/WG-I will then produce a table of requirements (an example is set out in Table 12.1) synthesizing the regional requirements by top-level high-priority variables, with an indication of the most stringent threshold⁴⁹ and breakthrough requirements to be met across the relevant application areas. The table focuses on horizontal resolution, observing cycle and timeliness, and which observing technology can be used. Other criteria, such as vertical resolution, uncertainty and stability can be addressed when RBON stations are proposed and discussed with the Members to assess whether such stations meet the RBON requirements or whether they could or should be upgraded to meet them.

The following methodology is proposed:

- Identify the application areas which are expected to substantially benefit from addressing the key regional challenges;
- For each such application area, identify the top-level high-priority variables to be observed;
- Identify the main observing technologies that are used or could be used to observe the identified top-level high-priority variables. Information on available technologies by variable is available in the *High-Level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040* (WMO-No. 1334);
- Start with one requirement table for each of the relevant application areas and consult the OSCAR/Requirements database to find the threshold requirements to be used for observations (see example in Table 12.1). Consideration will be given to the most important criteria to be considered (for example, horizontal resolution, [observing cycle](#), [timeliness](#), and so forth). Regional subject matter experts may wish to propose regional requirements different from the global ones in the database. In such cases, they should consult with the Rolling Review of Requirements Points of Contact of the relevant application areas to have these requirements assessed, agreed upon and entered in the database if consensus is achieved;
- Merge the obtained requirement tables into one table, considering the most stringent requirements for top-level high-priority variables to be observed across the various application areas (Table 12.1 also provides an example). One example could be where “precipitation intensity at surface (liquid or solid)” is one of the top-level high-priority variables to be observed for the key regional challenge “Forecasting and management of high-impact weather events (e.g. flood)”. The two application areas identified as benefiting from improvements of observations for such a variable are Global Numerical Weather Prediction (NWP) and real-time monitoring and high-resolution NWP. In this

⁴⁹ The “threshold” is the minimum requirement to be met to ensure that data are useful.

case, it will be the most stringent threshold requirement of high-resolution NWP (which is 10 km as opposed to 50 km) that will be used for the horizontal resolution.

Table 12.1. Example of required top-level high-priority variables, the targeted key regional weather, climate, water and other environmental challenges, horizontal resolution, observing cycle and timeliness requirements and the available observing technologies⁵⁰

Key variable	Targeted key regional challenges	Horizontal resolution (threshold)	Observing cycle (threshold)	Latency (threshold)	Observing technologies ⁵⁰
Precipitation intensity at surface (liquid or solid)	Forecasting and management of high-impact weather events (e.g. flood)	10 km ⁵¹ or TBD by regional expert	2h or TBD by regional expert	2h or TBD by regional expert	Satellites, Weather radars, Precipitation gauges
Wind profile (PBL)	Forecasting of convective events and associated hazard	10 km or TBD by regional expert	12h or TBD by regional expert	2h or TBD by regional expert	AMDAR/MODE-S at airport, Wind profiler, Weather radars, Radiosonde
Temperature profile (PBL)	Forecasting of convective events and associated hazard	10 km or TBD by regional expert	3h or TBD by regional expert	2h or TBD by regional expert	Aircraft (AMDAR or Mode-S), Raman lidar

12.2.3 Assessment of capabilities

All surface-based observing stations that can potentially contribute to RBON must be recorded in OSCAR/Surface so that the RA/WG-I can make an informed assessment of the observing capabilities of the region. The [WDQMS](#) can also be used to identify which stations are actually reporting and which data are used by global NWP and other types of centres. Further consultation with Members will also allow identification of additional existing observing infrastructure currently not reporting internationally or not included in RBON, and which could potentially and immediately be used for inclusion in RBON at a relatively limited cost (for example, by adding the data exchange mechanism at the required reporting frequency).

12.2.4 Gap analysis

On the basis of the key regional challenges, regional requirements (Table 12.1) and existing capabilities, and taking into account the composite nature of the observing system (including in situ and remote sensing, surface-based and space-based observing stations), the RA/WG-I performs a gap analysis and identifies the gaps that ought to be filled. To assess capabilities,

⁵⁰ See *High-Level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040* (WMO-No. 1334)

⁵¹ Here based on the most stringent threshold requirements for global and regional NWP

the gap analysis can be done using tools such as OSCAR/Requirements, [OSCAR/Space](#) and OSCAR/Surface and the WDQMS, as well as through consultation with Members in the region.

The outcome of the gap analysis should be a table summarizing the following information:

- Key gap name;
- Short description of the gap, including the key regional challenges, application areas negatively impacted by the gap, and the top-level high-priority variables to be observed;
- Main requirement criteria to be addressed, among the following (one or more):
 - Description of the geographic area lacking data (for example, latitude/longitude box, name of an area, and so forth);
 - Horizontal resolution of additional RBON observations needed to achieve assessed requirements, and the number of observation sites that would be needed in the specified geographic area to fill the gap;
 - Vertical resolution;
 - Data availability including observing cycle and latency;
 - Long-term commitment for operating the station under RBON, at least four (4) years.
- Potential observing technologies that could be proposed as good candidates for RBON station(s) (see Annex 2 of *High-Level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040* ((WMO-No. 1334)));
- Other existing observing technologies that complement RBON data, for example, research or partner or private sector observing stations;
- Possible approaches for the longer term (such as use of emerging technologies,⁵² use of capacity development instruments, negotiation with partner organizations regarding specific types of data, and so forth).

12.2.5 Options for the selection of stations

The outcome of the gap analysis is communicated by the RA/WG-I to Members via their WIGOS national focal points; dialogue is initiated with Members to identify candidate observing stations to be committed to RBON according to the criteria provided in 12.2.6. Approaches for the longer term are also discussed. The Members' goal is to develop an updated and consolidated list of national observing stations committed to RBON, together with a national RBON implementation plan for the longer term. The Regional WIGOS Centres may also assist in the process.

Options for the selection of stations include the following:

- (a) Existing observing stations that already meet RBON requirements, whether or not they are already part of RBON.
- (b) Existing observing stations that do not fully meet RBON requirements, but could be easily upgraded to meet them. For example, for stations which meet all requirements except the

⁵² The *High-level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040* (WMO-No. 1334) also provides, in its Annex 2, information on emerging technologies, by variable.

requirement for data exchange, it could be decided to make the data internationally available.

- (c) Partner observing stations that could be committed to RBON, provided that a Memorandum of Understanding (MoU) is negotiated and signed at the national level between the Permanent Representative (PR) of the Member and the partner organization, to ensure that the RBON requirements will be met. Partnerships for sharing resources can also be considered, that is, when a station upgrade is necessary to meet all RBON requirements.
- (d) New observing stations to be implemented and start operations in the foreseeable future (that is, less than one year after the regional association decides on the updated composition of RBON). This scenario would be for addressing some remaining critical gaps (by observed variable) which should be filled. The Members should investigate whether investments could be made in order to implement such stations. Developing countries may wish to consider using some of the capacity-development instruments, such as the WMO Country Support Initiative (CSI),⁵³ for making such investments.
- (e) In some instances, it is recognized that a Member may find that the horizontal and/or temporal resolutions required according to the RBON-related sections 3.2.3.7 and/or 3.2.3.9 of the *Manual on the WIGOS* are not practically achievable for the observing network within parts of its territory. In that case, the Member shall inform the Secretary-General of the reasons, as per Article 9 (b) of the WMO Convention, and paragraph 6 of the General Provisions of the *Technical Regulations* (WMO-No. 49), Volume I.

When investments at the national level are needed, and implementation cannot be realized quickly enough for the stations to be ready to report within one year after the regional association is expected to decide on the new RBON composition, a national RBON implementation plan with a clear timeline should be provided to the RA/WG-I. The national implementation plan will then be part of the regional implementation plan for RBON.

12.2.6 Criteria for the selection of stations

The following criteria are applied by Members when selecting existing stations that could contribute to RBON:

12.2.6.1 Observing network design principles

Observing network design principles (ONDP) are followed in accordance with the *Manual on the WIGOS*, 2.2.2.1 and Appendix 2.1. Most of the design principles are already met by simply complying with RBON or WIGOS technical regulations, namely the *Manual on the WIGOS*, as detailed in Table 12.2. Focus should therefore be placed on the following principles (principles 4, 5 and 6, also outlined in Table 12.2), which are not directly addressed by such technical regulations:

- i. ONDP #4: Designing appropriately spaced networks;
- ii. ONDP #5: Designing cost-effective networks;
- iii. ONDP #6: Achieving homogeneity in observational data.

More details on how to apply these principles can be found in Chapter 5 of the present Guide.

⁵³ <https://alliancehydromet.org/soff/country-support-initiative/>

Table 12.2. Observing network design principles and how they are considered in RBON

No.	Principle	Comments
1	Serving many application areas	Addressed by definition through RBON provisions 3.2.3.7 , 3.2.3.9 , 3.2.3.10, 3.2.3.11 of the <i>Manual on the WIGOS</i>
2	Responding to user requirements	Addressed by definition through RBON provisions 3.2.3.7 , 3.2.3.8, 3.2.3.9 , 3.2.3.10, 3.2.3.11 of the <i>Manual on the WIGOS</i>
3	Meeting national, regional and global requirements	Addressed by definition through RBON provisions 3.2.3.7 , 3.2.3.8, 3.2.3.9 , 3.2.3.10, 3.2.3.11 of the <i>Manual on the WIGOS</i>
4	Designing appropriately spaced networks	To be considered in the design process by the RA/WG-I. See Chapter 6 and paragraph 12.2.6.8 of the present Guide.
5	Designing cost-effective networks	To be considered in the design process by the RA/WG-I. See Chapter 6 of the present Guide.
6	Achieving homogeneity in observational data	To be considered in the design process by the RA/WG-I. See Chapter 6 of the present Guide.
7	Designing through a tiered approach	RBON forms baseline network
8	Designing reliable and stable networks	Addressed by definition through 4-year/10-year commitment of Member, as per RBON provision 3.2.3.5 and 2.2.1.2 of the <i>Manual on the WIGOS</i>
9	Making observational data available	Addressed by definition through commitment of Member, as per RBON provision 3.2.3.4 of the <i>Manual on the WIGOS</i>
10	Providing information so that the observations can be interpreted	Addressed through commitment of Member to submit WIGOS Metadata in OSCAR/Surface, as per WIGOS provisions 2.5.1.1 , 2.5.1.2 of the <i>Manual on the WIGOS</i>
11	Achieving sustainable networks	Addressed by definition through 4-year/10-year commitment of Member, as per RBON provisions 3.2.3.5, 2.2.1.2 of the <i>Manual on the WIGOS</i>
12	Managing change	Addressed by definition through commitment of Member, as per these principles and provision 3.2.3.6 and 3.4.6 of the <i>Manual on the WIGOS</i>
<u>13</u>	<u>Advancing environmental sustainability.</u>	<u>Addressed through commitment of Member to consider the environmental impacts of observing networks in their design and operation</u>

12.2.6.2 Observing station technologies considered for RBON

All surface-based observing technologies can a priori be considered for inclusion in RBON. These include the technologies used for the traditional former Regional Basic Synoptic Network (RBSN) and Regional Basic Climatological Network (RBCN) stations, but also aircraft observing systems, operational weather radars and other surface-based remote-sensing observing stations, hydrological observing stations, agricultural meteorological stations, marine observing stations (fixed or mobile), and so forth.

12.2.6.3 Compliance with RBON requirements

The station (or network in case of mobile stations) can contribute to meeting the RBON requirements (some upgrade may be needed). See Table 12.3.

12.2.6.4 Willingness of Member to commit

The Member is willing to commit the station (or network, in the case of mobile stations) to RBON according to the RBON requirements, and to upgrade it if necessary. In accordance with the *Manual on the WIGOS*, 3.2.3.5, there is at least a 4-year minimum commitment, and at least 10 years is recommended, according to 2.2.1.2.

12.2.6.5 Former Regional Basic Synoptic and Climatological Networks

Former Regional Basic Synoptic Network and Climatological Network (RBSN and RBCN) stations are preferably kept in RBON for continuity of the time series, although they may have to be upgraded for compliance with RBON requirements.

12.2.6.6 Consideration of the High-Level Guidance on the Evolution of Global Observing Systems during the period 2023–2027 in Response to WIGOS Vision 2040 (WMO-No. 1334)

The Infrastructure Commission has developed the *High-Level Guidance on the Evolution of Global Observing Systems during the Period 2023–2027 in Response to the Vision for WIGOS in 2040* (WMO-No. 1334), whose purpose is to provide guidance to WMO Members for key activities to be implemented within the five years from 2023 to 2027 to accomplish the scenario of the [Vision for the WMO Integrated Global Observing System in 2040](#) (WMO-No. 1243). The guidance consists of principles of a general nature that should be considered for the development of implementation plans by Members, agencies and other operators of observing networks. It identifies urgent specific actions arising as a consequence of WMO's Earth System approach and in response to the priorities of WIGOS, WMO programmes and existing data gaps. Elements and priority actions from this document should be considered during the design of RBON for the selection of observing stations.

12.2.6.7 Avoid duplication and overlap

If the station (or network, in the case of mobile stations) is included in RBON, it should not duplicate or overlap with other existing RBON observations or other existing sources of data made available to WMO Members (such as satellite data) from the considered area. Indeed, RBON stations are expected to add value in terms of meeting the threshold up to breakthrough requirements for top-level high-priority variables to be observed in support of priority application areas. For example, the horizontal resolution requirements are very demanding for some applications, such as high-resolution NWP (HRNWP) and Nowcasting/very short-range forecasting (VSRF), even at the threshold level. Such requirements are likely to be met by RBON only over very limited domains but not over regional or global domains. In this case, the design of RBON would need to take into account how its surface stations/platforms could complement the observations available from space or other surface-based remote-sensing observing platforms (for example, lower tropospheric wind (horizontal) for HRNWP).

12.2.6.8 Even distribution of stations

The horizontal resolution of observations by variable (possibly coming from different types of observing stations) should be relatively even across the region or specific climate zone. The distribution of the RBON stations across Members should be fair and equitable among Members, taking into account their capabilities and the available resources.

12.2.6.9 Small size Members

Members whose geographical area is below the most stringent threshold requirement for horizontal resolution across applications for the observed variables should commit at least one RBON station, unless the requirements are already met with the data from other surrounding RBON stations or from satellite or other remote-sensing observations. These Members can rely on the RBON stations from the surrounding Members to have the spatial resolution requirements met at least at the threshold level.

12.2.6.10 Members with larger geographical coverage

Members with larger geographical coverage will design and propose their own national observing network contributing to RBON. However, for the stations to be committed near⁵⁴ their borders they are urged to consult with neighbouring Members and with the RA/WG-I regarding options to be considered for the best selection of RBON stations.

12.2.6.11 Mobile stations commitment

For mobile stations, the commitment is made for a national network or for a national contribution to another observing network (for example, to the Data Buoy Cooperation Panel (DBCP) for drifting buoys, or to the Voluntary Observing Ship (VOS) scheme for ships). Members will have to define what their commitment to such a network will be in terms of: (i) geographic coverage and area of operations or deployment; (ii) duration of the programme and long-term commitment; and (iii) targeted network density or number of committed stations. Once such a network of mobile stations is approved by the regional association to be part of RBON, its observing stations are then automatically affiliated to RBON as they are deployed, without the need for the regional association to re-apply the RBON design process or approve them individually.

Table 12.3. Summary of the RBON requirements according to the *Manual on the WIGOS*

Requirement	Mandatory requirements (shall)	Recommended requirements (should)
Respond to user requirements as specified in OSCAR/Requirements	3.2.3.3, 3.2.3.6	n/a
International exchange of the data in real time or near-real time	3.2.3.4	n/a
4-year operations commitment	3.2.3.5	n/a

⁵⁴ In this context, the term “near” is interpreted as being at a distance from the border of less than half of the horizontal resolution required.

Requirement	Mandatory requirements (shall)	Recommended requirements (should)
10-year operations commitment	n/a	2.2.1.2
Set of stations/platforms to enable RBONs to meet [for the identified top-level high-priority variables], at threshold levels or better, observational requirements of all [prioritized] WMO application areas	3.2.3.7	n/a
Sub-set of stations that enables RBONs to meet [for identified top-level high-priority variables] observational requirements of at least some application areas at the breakthrough level or better	n/a	3.2.3.8
Sub-set consisting of stations/platforms that observe [key] surface variables with an hourly or more frequent observing cycle, sufficient to meet the threshold observing cycle requirements of all [prioritized] application areas	3.2.3.9	n/a
Enough stations/platforms that observe surface pressure to enable RBON to have horizontal resolution of 100 km or better for surface pressure observations Note: The GBON requirement is 200 km over land and 500 km over the ocean in Exclusive Economic Zones (EEZs).	n/a	3.2.3.10
Enough upper-air stations/platforms to enable RBON to have horizontal resolution of 100 km or better for vertical profile observations of the horizontal wind vector. Note: The GBON requirement is 500 km over land and 1000 km over the ocean in EEZs.	n/a	3.2.3.11
Monitor RBON performance and rectify identified non-conformance	3.2.3.17, 3.2.3.18	n/a

12.3 PROCEDURE FOR ASSIGNMENT OF RBON STATIONS AND RBON EVOLUTION

12.3.1 Information provided by Members to the Regional Association Working Group on Infrastructure

Members will provide the Regional Association Working Group on Infrastructure (RA/WG-I) with their updated list of stations to be committed to RBON (see Template for the proposed updated composition and selection of RBON stations addressing the key gaps in Annex 3), together with their draft national plan on the evolution of RBON to address remaining gaps over the longer term (work with partners, timeline for implementation of new stations, promotion of new studies, use of new technologies, use of capacity-development instruments such as the Country Support Initiative (CSI), and so forth) (see Template for the draft national or regional plan on the evolution of RBON to meet remaining gaps over the longer term in Annex 4).

12.3.2 Synthesis of the updated composition of RBON

Based on guidance from the management group, in particular with regard to the key regional weather, climate, water and other environmental challenges to be met with RBON

observations, and based also on interactions and input from Members as described in 13.3.1, the RA/WG-I will finalize the design of RBON and submit to the regional association management group the following material for its consideration:

- (a) The list of key regional challenges with a summary of regional requirements for some top-level high-priority variables to be observed by RBON (global requirements are used by default) (Table 12.1);
- (b) The gap analysis summary describing the key gaps and a proposal for technologies to potentially be used to fill the gap;
- (c) The proposal for an updated composition and selection of RBON stations addressing the key gaps (it is understood that there may still be remaining gaps). See Template for the proposed updated composition and selection of RBON stations addressing the key gaps in Annex 3;
- (d) The draft plan on the evolution of RBON or roadmap to fill the remaining gaps in meeting the requirements of the key regional challenges over the longer term (work with partners, timeline for implementation of new stations, promotion of new studies, use of new technologies, use of capacity-development instruments such as the CSI, and so forth). See Template for the draft national or regional plan on the evolution of RBON to meet remaining gaps over the longer term in Annex 4.

12.3.3 Assignment of RBON stations, and the plan or roadmap for the evolution of RBON by the regional association

The assignment of RBON stations is made by Members in OSCAR/Surface. Once the stations are assigned to RBON they will be included in the regular compliance monitoring as described in 12.4.4. The regional association decides on the plan or roadmap for the evolution of RBON to fill the remaining gaps.

12.4. FOLLOW-UP ACTIONS AND COMPLIANCE MONITORING

12.4.1 Reflecting updated composition of RBON in OSCAR/Surface

Once Member has decided on their contribution to RBON, the OSCAR/Surface NFPs must affiliate their committed stations to RBON in OSCAR/Surface² and have the stations' WIGOS metadata recorded. Possible discrepancies in metadata will be discussed with the WIGOS NFPs or Members (if no WIGOS NFP), in consultation with the RA/WG-I.

12.4.2 Recommendations to address remaining gaps

It is understood that the agreed composition of RBON in the region may not entirely meet the observational user requirements for the region and that gaps may remain, essentially due to a lack of capacity of some Members from developing or least developed countries. The use of capacity development and other financing instruments should therefore be considered for filling the gaps over the longer term. Proposed actions will be detailed in the regional plan or roadmap for the evolution of RBON.

12.4.3 Review cycle of the RBON performance, composition and evolution

The performance, composition and evolution of RBON is reviewed every four years. However, Members can make adjustments in the meantime in accordance with the *Manual on the WIGOS*, 3.2.3.16.

12.4.4 Monitoring of compliance with the RBON requirements

Compliance of [the](#) RBON with the requirements specified in the *Manual on the WIGOS* is routinely monitored by the Regional WIGOS Centres (RWCs), which regularly report on issues, inconsistencies or gaps. Members are tasked with taking actions as needed on the identified issues and discrepancies. The RA/WG-I takes the information from the RWCs into account when proposing an updated composition of [the](#) RBON to the regional association.

Note: RA/WG-I will also be provided with a brief national plan with a timeline for the further evolution of the national contribution to RBON.

ANNEX 1. SUMMARY OF THE ROLE OF VARIOUS BODIES IN THE RBON DESIGN PROCESS

Body	Role
Members	Nominate WIGOS, OSCAR/Surface and WIGOS Data Quality Monitoring System (WDQMS) NFPs. Propose and commit existing stations (consider national partnerships and upgrading stations to meet RBON requirements if needed). Take action to fill remaining gaps. Implement new RBON station(s) as committed. Developing countries may wish to make use of capacity-development instruments, e.g. Country Support Initiative (CSI), Systematic Observations Financing Facility (SOFF, applicable to GBON requirements only). Record station metadata in OSCAR/Surface. Correct compliance issues.
WIGOS NFPs (see Chapter 6, Annex 1)	Assist the RA/WG-I regarding RBON design. Inform on Country/Territory capabilities. Negotiate with partner organizations and encourage non-NMHS observing stations to be made available when they meet RBON requirements. Identify potential candidate RBON stations. Identify which stations are to be upgraded to meet RBON requirements. Task OSCAR/Surface NFPs to (i) affiliate station to RBON, and (ii) record metadata in OSCAR/Surface.
OSCAR/Surface NFPs (see Chapter 6, Annex 1)	Assign WIGOS Station Identifiers to RBON stations. Enter and maintain WIGOS metadata of RBON stations in OSCAR/Surface. - Assign appropriate stations to RBON. - Un-assign stations from RBON in OSCAR/Surface when such stations can no longer be committed to RBON by the Member.
WDQMS NFPs (see Chapter 6, Annex 1)	Address identified compliance and incident issues.
Regional associations	Appoint subject matter and observing network design experts to be working within or with the RA/WG-I on RBON design. Task the RA/WG-I to undertake RBON design (there may be a need to update their Terms of Reference; and the RA/WG-I may wish to establish a Task Team on RBON design). Decide on a small number of key regional weather, climate, water and other environmental challenges to be used for RBON design. Decide on regional requirements based on the key regional challenges to be used for RBON design. Decide on the regional plan for the evolution of RBON to address remaining gaps.
	–
Regional association management groups	Advise on key regional weather, climate, water and other environmental challenges to be addressed by the RBON design. Review proposals from the RA/WG-I with regard to the draft plan on the evolution of RBON to address remaining gaps. Advise the president of the regional association on these proposals.

Body	Role
RA/WG-I (or its established task team on RBON design)	Promote regional cooperation and exchange of data across boundaries: share benefits and resources and optimize the deployment of observing stations geographically; propose prioritization mechanism(s) for such cooperation, e.g. in support of disaster risk reduction; and facilitate processing of RBON data and the use of existing global and regional infrastructure (e.g. WMO Information System (WIS) centres). Coordinate the design process at the regional level. Propose regional requirements (to be recorded in OSCAR/Requirements) based on the list of high-priority regional weather, climate, water and other environmental challenges, and the top-level high-priority variables to be observed to address such challenges. Conduct gap analysis (compare requirements with Members' observing capabilities). Consult with and provide information on the regional requirements to the Rolling Review of Requirements (RRR) Points of Contact of WMO application areas so that these and regional priorities can also be considered in OSCAR/Requirements and the Statements of Guidance. Share efforts and knowledge to carry out and coordinate impact studies, as or if needed. Obtain proposals from Members on candidate observing stations to be included in RBON. Propose to regional association (in consultation with Members): (a plan on the evolution of RBON to address remaining gaps (promote new studies, use new technologies, use capacity-development instruments e.g. CSI, etc.).
Regional Centres WIGOS	Assist RA/WG-I on RBON design. Monitor compliance of RBON. Alert Members on non-compliance issues.
Secretariat	Check and confirm affiliation to RBON in OSCAR/Surface. Discuss possible issues with NFPs and Members, if needed, in consultation with RA/WG-I. Assist Members to fill remaining gaps by advising on existing capacity-building instruments such as CSI or SOFF.

ANNEX 2. EXAMPLES OF KEY REGIONAL WEATHER, CLIMATE, WATER AND OTHER ENVIRONMENTAL CHALLENGES

1. EXAMPLE OF CHALLENGES

Key definitions

Key regional weather, climate, water and other environmental challenges (in the context of RBON) are weather, climate, water and other environmental phenomena to be addressed in order to bring substantial socioeconomic benefits to the region through the use of RBON data. (Note: the warnings of hazardous events are challenges, but there are other types of challenges that are not about issuing warnings of hazardous events (for example, support to aviation, agricultural meteorology, irrigation).

Hazard: A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.

Hazardous Event: The manifestation of a hazard in a particular place during a particular period of time. Annotation: Severe hazardous events can lead to a disaster as a result of the combination of hazard occurrence and other risk factors.

Disaster: A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts.

Source: UNDRR open-ended intergovernmental expert working group on indicators and terminology <https://www.undrr.org/terminology>.

The WMO Event Types List contains a standard list of event types that can be potentially associated with hazardous events. The list is intended to be a living list that can be amended through the appropriate WMO governance mechanism with inputs from WMO Members, WMO regional associations as well as collaborating institutions having a mandate on other hazards. The events list will facilitate the standardization of event terminology across various domains of applications. Event definitions can be referred to in the WMO relevant technical regulations.

The “priority hazards” as identified by the Early Warnings for All initiative are marked in bold.

LIST OF EVENTS

1. _____ Avalanche
2. _____ Cold wave
3. _____ **Drought/Dry spell**
4. _____ Dust storm/Sandstorm
5. _____ Extra-tropical cyclone
6. _____ **Flood**
7. _____ Fog
8. _____ Forest fire
9. _____ Freezing rain
10. _____ Frost
11. _____ Hail
12. _____ Haze/Smoke
13. _____ **Heatwave**
14. _____ High Seas/Rogue waves etc.
15. _____ High UV radiation
16. _____ Icing
17. _____ Landslide/Mudslide & Debris flow
18. _____ Lightning
19. _____ Pollen pollution/Polluted air
20. _____ Rain/Wet Spell
21. _____ Snow
22. _____ Snowstorm
23. _____ Space weather event
24. _____ Storm surge/Coastal flood
25. _____ **Thunderstorms/Squall lines**
26. _____ Tornado
27. _____ **Tropical cyclone**
28. _____ Tsunami
29. _____ Volcanic ash
30. _____ Wildland fire
31. _____ Wind

The above WMO Event Types List contains a standard list of event types that can be potentially associated with hazardous events and can be considered by the regional associations when designing their RBON networks. Regional associations normally consider a small number of challenges to be addressed at the regional level when designing their RBON networks.

In addition, for planning (risk assessment), preparing (forecasting) and responding (warning and informing) to the multi-sectorial impacts. Regional associations can consult the following list of key regional weather, climate, water and other environmental challenges:

- Heavy rainfall; pluvial, fluvial and groundwater flooding; flash floods;

- Coastal inundation, storm surge, large waves and tsunamis, coastal erosion;
- Strong winds, windstorms and squall lines (land and oceans), wind conditions (e.g. impact on wind farms, aviation, tourism);
- Winter, polar and high-mountain weather (extreme cold and cold waves, freezing rain, snow, snow depth, icing, avalanches, glacier lake outburst floods, landslides and rockfalls, thermokarst, and so forth);

Hurricanes/typhoons;

- Air quality and aeroallergens;

Low cloud and poor visibility;

Extreme heat (impacts on health, agriculture, wildfire and so forth);

- Severe convection (gust fronts, microbursts, severe icing/turbulence for aviation, and so forth);
- Sand and dust (suspension, deposition and sedimentation);
- Dry air;
- Space weather;
- Volcanic gases and sulfates (suspension, deposition and sedimentation);
- Climate change (in Earth systems domains);
- Changes in weather regimes in the medium range (up to 30 days) and seasonal range (multi-month);
- Marine pollution (e.g. oil spills);
- Water quality (e.g. algae blooms).

Regional associations may choose to disregard certain challenges from the list or to consider others that are not on the list.

2. EXAMPLES OF HOW TO ADDRESS CHALLENGES

The following table provides examples of how to address some key regional challenges with the goal of identifying the key gaps to be addressed through RBON data. These examples are given solely as a starting point; regional associations are invited to organize themselves and the related activities in order to fine tune their requirements, taking into account the actual gaps and capacities of the Members in the region.

No.	Key regional challenge	Which tools or application areas are being used to address the key challenge?	What are the key variables to be observed in order to address the key challenge?	Available observing technologies ⁵⁵	Comment
1	Forecasting and management of pluvial floods (a high-impact weather event)	GNWP; HRNWP; Hydrological and hydrodynamical models; Mathematical models; Statistical models.	Precipitation intensity at surface (liquid or solid); Evaporation; Water level; Discharge; Soil moisture; Underground water.	Satellites; Weather radars; Precipitation gauges; River gauges; Flooding level monitoring stations.	Near-surface winds (convergence zones) and boundary-layer (BL) humidity would also be relevant for forecasting with high-resolution forecast models. HRNWP with cloud resolving schemes with fast assimilation cycles would be particularly useful. Updated databases of land use and soil classification would be useful.
2	Forecasting of convective events and associated hazards	GNWP; HRNWP; Nowcasting; Aeronautical meteorology.	Wind profile (BL); Temperature profile (BL); Humidity profile (BL); All basic atmospheric surface variables; Precipitation.	Automatic Weather Station (AWS) (including rain gauge); Radiosonde AMDAR/MODE-S at airport; Low latency, high temporal and spatial resolution satellites and surface-based remote-sensing stations, including lightning detection; Raman lidar (humidity, temperature); DIAL lidar (humidity); GNSS ZTD; Doppler lidar; Wind profiler; Weather radars; Lightning detection network.	This includes flood, flash flood, damaging wind, lightning storm, tornadoes

Key: GNWP = Global numerical weather prediction; HRNWP = High-resolution numerical weather prediction; GNSS ZTD = Global navigation satellite system zenith total delay

3. Examples of related regional activities

- RA-II: Implementation of the RRR in China ([pdf](#))

⁵⁵ The *High-level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WIGOS in 2040* (WMO-No. 1334) provides in its Annex 2, "Statements of Guidance gap overview per variable", comprehensive information on existing and emerging technologies for measuring the variables where gaps have been identified for WMO application areas.

- RA-VI: EUMETNET has developed a series of regional Statements of Guidance, which are available at <https://www.eumetnet.eu/activities/observations-programme/documents/>

ANNEX 3. TEMPLATE FOR THE PROPOSED UPDATED COMPOSITION AND SELECTION OF RBON STATIONS ADDRESSING THE KEY GAPS

Note: The same template is used for the national list of stations (submitted by Members to the RA/WG-I) and the full proposed updated composition of RBON for the region (developed by the RA/WG-I based on Members' input).

WS I ¹	WMO Member ²	Status ³ (E/N)	Latitude ⁴	Longitude ⁴	Type of observing station	Surface observations (Y/N)	Upper-air observations (Y/N)	Commitment ⁵	Owner ⁶	Comment ⁷

Key:

1. WIGOS Station Identifier
2. Country or territory
3. Existing RBON station (E) or new proposed station (N)
4. Provide information in decimal format
5. Number of years the station is committed from the time of expected decision by the regional association
6. NMHS or name of partner organization
7. Additional information, e.g. limitations per RBON requirements, known issues, clarifications

ANNEX 4. TEMPLATE FOR THE DRAFT NATIONAL OR REGIONAL PLAN ON THE EVOLUTION OF RBON TO MEET REMAINING GAPS OVER THE LONGER TERM

Notes:

1. The same template is used for national plans (submitted by Members to the RA/WG-I) and regional plans (developed by the RA/WG-I based on national plans provided by Members).
2. Entries in the table below are only given as examples.

No.	Deliverable	By whom	Expected delivery time	Comment
1	MoU with partner organization for upgrading <N> <station type> stations in <name of region>	NMHS and <partner name>	6/2026	Number of stations to be upgraded will depend on negotiation with partner organization and available resources
2	MoU with partner organization for the exchange of data from <N> <station type> stations in <name of region>	NMHS and <partner name>	3/2024	Good chances of success; data already shared by the partner with NMHS
3	Plan for funding <N> new <station type> stations to be implemented	NMHS and WB	2028	

No.	Deliverable	By whom	Expected delivery time	Comment
	in <name of region> using the World Bank (WB) funding in the framework of the WMO Country Support Initiative			
4	Agreement with neighbouring country for sharing and exchanging weather radar data	NMHS and <country name>	12/2025	Investigating future agreement with <country name> for the exchange of data
5	Implementation of new weather radar in <name of region>	NMHS	6/2024	Investigating future agreement with <country name> for the exchange of data
6	Testing use of UAS technology to replace some upper-air soundings at 0000 UTC	NMHS and <research institute>	2026	Implementation will depend on the results
7	Impact study on the impact of AMDAR observations in the presence of upper-air radiosonde data	NMHS	5/2024	Could lead to decisions on optimal mix of observations based on the results
8	Upgrade of <N> GBON stations to meet RBON requirements	NMHS and hydrological institute	3/2025	

Key: MOU = Memorandum of Understanding; N = number; UAS = unstaffed aerial systems

Резолюция 5 (ИНФОМ-3)

Обновление Технических руководящих принципов для региональных центров ИГСНВ (РЦИ) по системе мониторинга качества данных ИГСНВ (ВМО-№ 1224)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 19 \(ИС-70\)](#) «Руководство по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1165)», включающее Технические руководящие принципы для РЦИ по системе мониторинга качества данных (СМКДИ) в отношении наземных станций Глобальной системы наблюдений (ГСН),
- 2) [резолюцию 19 \(ИС-76\)](#) «Руководство по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1165)»,
- 3) [резолюцию 20 \(ИС-76\)](#) «Руководство по Глобальной опорной сети наблюдений»,
- 4) [резолюцию 47 \(Кг-19\)](#) «Обязательные публикации ВМО и политика в области распространения на девятнадцатый финансовый период»,

отмечая значительные обновления Технических руководящих принципов, разработанные Экспертной группой по инструментам ИГСНВ и деятельности РЦИ (ЭГ-ИИР) и затем рассмотренные Постоянным комитетом по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ),

отмечая также [резолюцию 4 \(ИНФОМ-3\)](#) «Обновление *Руководства по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1165)», в отношении которого Технические руководящие принципы содержат дополнительные руководящие указания,

изучив проект обновления [Технических руководящих принципов для региональных центров ИГСНВ по системе мониторинга качества данных ИГСНВ](#) (ВМО-№ 1224), приведенный в дополнении к настоящей резолюции,

принимает обновленные [Технические руководящие принципы для региональных центров ИГСНВ по системе мониторинга качества данных ИГСНВ](#) (ВМО-№ 1224), приведенные в дополнении к настоящей резолюции;

предлагает Членам, на территории которых располагаются РЦИ, а также всем национальным координаторам по СМКДИ:

- 1) осуществлять и соблюдать *Технические руководящие принципы* при выполнении функций РЦИ;
- 2) представлять ИНФОМ свои предложения относительно того, каким образом совершенствовать последующие версии *Технических руководящих принципов*;

порукает ПК-СНСМ продолжить совершенствование веб-инструмента системы мониторинга качества данных ИГСНВ (СМКДИ) с учетом требований РЦИ для их эффективной работы, принимая во внимание расширяющиеся функции и обязанности по реализации ГОСН;

порукает своей Группе управления обеспечить продолжение разработки и совершенствования *Технических руководящих принципов* посредством включения дополнительных материалов по мере их поступления.

Дополнение к резолюции 5 (ИНФОМ-3)

Обновление Технических руководящих принципов для региональных центров ИГСНВ (РЦИ) по системе мониторинга качества данных ИГСНВ (ВМО-№ 1224)

Technical Guidelines for Regional WIGOS Centres on the WIGOS Data Quality Monitoring System

INTRODUCTION

This publication [provides detailed technical guidance in addition to the contents of ~~is an Annex to~~ Chapters ~~9, 7 and 8~~ of the *Guide to the WMO Integrated Global Observing System* \(WMO-No. ~~1165, 2018~~\)](#). ~~It provides detailed technical guidance~~ for Regional WMO Integrated Global Observing System (WIGOS) Centres (RWCs) to run the operational activities related to the WIGOS Data Quality Monitoring System (WDQMS), ~~specifically for the surface stations of the Global Observing System (GOS) located on land (on the territories of WMO Regional Association (RA) Members)~~. Although it is envisaged to address multiple components of WIGOS and observing networks of the Global Observing System (GOS), the current scope covered in this edition addresses specifically the surface-based stations of the GOS, including Global Basic Observing Network (GBON) stations, located on land.

~~These guidelines describe the three main functions of~~ It contains guidelines to perform the mandatory functions of an RWC described in chapter 8 (WMO-No. 1165), i.e. WIGOS metadata management and WDQMS (monitoring, evaluation and incident management), as well as the requirements (such as the resources needed) and the recommended practices and procedures to perform those functions ~~for the surface land stations of GOS. They include the daily~~ These guidelines describe the tasks for RWC staff ~~and of the relevant National Focal Points (NFP)~~⁵⁶ in charge of the (sub)regional monitoring, evaluation and incident management activities for identifying, assessing and tracking issues related to ~~stations metadata in OSCAR/Surface~~⁵⁷ as well as data availability, timeliness and ~~quality~~ (accuracy)⁵⁸ from surface and upper-air stations, and also some recommended performance targets for both types of observations.

~~These guidelines are bounded by the current scope of the WIGOS operational tools (OSCAR/Surface webtool, WDQMS webtool and Incident Management System webtool), in terms of observing stations they cover, in particular by the observations that are integrated into the WDQMS Webtool. It is envisaged that in the future there will be semi-automated WIGOS Monitoring Centres providing routine reports and making available regional and thematic specific information to be used by RWCs. procedures for additional observing networks of the GOS such as Regional Basic Observing Networks (RBON)~~⁵⁹, or networks comprising of other than land stations, to be integrated into the WIGOS tools, as well as for other WIGOS components, such as cryosphere and hydrologic observations providing routine reports and making available specific monitoring information to be used by RWCs, for which further guidance will have to be developed.

1. FUNCTIONS

~~Two workshops on quality monitoring and incident management reviewed the monitoring of conventional components of GOS, such as surface land stations, based on numerical weather prediction (NWP) processes, towards modernization within the WIGOS framework. These WIGOS workshops were held in December 2014 and December 2015, where participants developed a design for~~ According to the Manual on WIGOS (WMO-No. 1160, Attachment 2.4) the WDQMS ~~to~~ consists of three basic functional components, which define the scope of WDQMS:

- WIGOS monitoring function
- WIGOS evaluation function
- WIGOS incident management function

~~These three components define the scope of WDQMS.~~ WIGOS Monitoring Centres will provide quality monitoring information on a daily basis in the form of quality monitoring reports. These reports are the basis of the WIGOS monitoring function and provide input to the WIGOS evaluation function. The evaluation function ~~should~~ extracts the relevant information from the quality monitoring reports together with metadata about the observing stations, from the Observing Systems Capability Analysis and Review (OSCAR)/Surface tool, ~~for the surface land stations of GOS,~~ and from the WMO Information System (WIS), and generates routine performance reports. Then, the WIGOS incident management function ~~will~~ takes up the issues

⁵⁶ ~~National Focal Points on WDQMS are the most relevant contacts from WMO Members to perform these functions~~

⁵⁷ ~~Observing Systems Capabilities, Analysis and Review tool for surface-based observations~~

⁵⁸ ~~See Annex 3 for a description of quality performance characteristics of a measurement or a set of measurements: accuracy, trueness and precision. For a better understanding the term 'quality' is used throughout the document~~

⁵⁹ ~~RBON, which now includes stations affiliated to the former RBSN, RBCN and ANTON, will be added in the future when the regional requirements and criteria for network design and implementation are clear.~~

that the evaluation function raised as incidents, and follows up the necessary action with the data supplier to resolve the issue. Figure 1 shows the interoperability of WDQMS.

Figure 1. Interoperability of WDQMS

The WMO Technical Regulations and their Annexes, including the Rolling Review of Requirements (RRR) process, provide the governance of WDQMS (~~WMO, 2011a, 2015a, 2015b, 2015c, 2015d, 2015e, 2015f~~). The ~~surface land observing~~ stations that are distributing observations via WIS provide the input to the WIGOS monitoring function. To run the incident management function, RWCs ~~will need to be in~~ closely collaboration with Members, which, in most cases, are responsible for incident rectification.

The WDQMS currently covers the surface-based stations of the GOS and GBON with plans to include the stations of RBON for variables which are common to GBON. In future, the WDQMS may be further extended to cover other WIGOS sub-component observing stations (e.g. weather radar and wind profilers).

The key official WIGOS tools used in the WDQMS include:

- OSCAR/Surface webtool (<https://oscar.wmo.int/surface>)
- WDQMS webtool (<https://wdqms.wmo.int>)
- Incident Management System webtool (<https://jira.wmo.int/>)

Other/Supplementary monitoring tools may be used when performing monitoring and evaluation functions.

The inputs, tasks and outputs of the three main functions of WDQMS are further described below.

1.1 WIGOS monitoring function

For practical implementation of WDQMS to GOS, the monitoring function is undertaken by WIGOS Monitoring Centres (for example, Global NWP Centres).

The WDQMS webtool⁶⁰ monitors the performance of some of the WIGOS observing components, namely the GOS land-based surface and upper-air (radiosonde) stations, the GBON surface and upper-air land-based stations, and the GCOS surface and upper-air land stations. The GOS and GBON monitoring is based on Numerical Weather Prediction (NWP) monitoring information provided by four global NWP centres at present and GCOS monitoring is based on data collected from the GCOS monitoring centres and includes the monitoring of the GCOS Surface Network (GSN) and of the GCOS Upper-Air Network (GUAN).

-Quality monitoring reports (for example, as a by-product of NWP data assimilation systems) for each station ~~of GOS should be~~ are generated and made available by the WIGOS Monitoring Centres on a daily basis for further use in quality monitoring and for the evaluation processes function.

1.2 WIGOS evaluation function

The evaluation function ensures that a universally applicable model can be applied to WDQMS. It takes the quality monitoring outputs from all the contributing WIGOS Monitoring Centres, extracts the relevant information from ~~WMO (2012) OSCAR/Surface~~ regarding the ~~distribution expected international exchange~~ of data on WIS/GTS according to the functions of WIS, ~~and~~

⁶⁰ See also Guide to WMO Integrated Global Observing System (WMO-No. 1165, Chapter 9)

~~from the OSCAR/Surface metadata database,~~ and generates routine daily performance reports based on at least two performance indicators:

- Comparison with the status of the availability of observations exchanged internationally according to the ~~expected planned~~ number of observations as described in ~~WIS and~~ OSCAR/Surface and in the WMO Technical Regulations.
- Trends in network performance over a suitable period (for observations of GOS, monthly rolling averages are proposed).

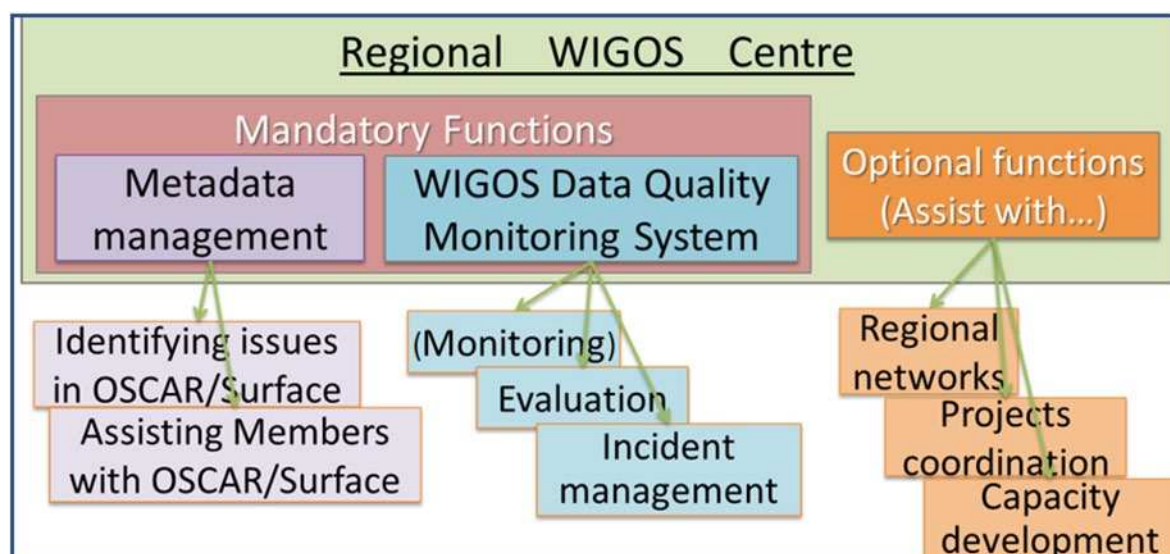
Additionally, the evaluation function uses the quality monitoring reports, which include issues identified with the observations from ~~surface land~~ stations, OSCAR/Surface status information, WIGOS Monitoring Centre features and other contextual information (such as geo-political, environmental, expectation of typical performance and exceptional circumstances), to determine if the observational issues identified should be formally raised as incidents with observational data providers. These observational data providers are usually, but not exclusively, National Meteorological and Hydrological Services (NMHSs).

~~During implementation of WDQMS and after the operational launch of RWCs, The~~ development of an automated alert system that issues alarms on the basis of the results of the WDQMS webtool ~~might~~ will be considered in future. These alarms could be in the form of emails to RWCs and the corresponding ~~national focal points (NFPs)~~, if a target was missed over a certain period of time. If possible, linking into national alerting systems might be beneficial for reducing duplication in alerting at national and regional levels.

1.3 WIGOS incident management function

If the issues considered by the evaluation function merit being raised as incidents, then the incident management function will undertake this. Clear communication of incidents with the suppliers of observational data, and also with users of the data to ensure they take suitable precautions with the source, is key to the success of the incident management function. The evaluation function monitors the status and successfulness of incident rectification. In most cases, the tasks to rectify incidents will be the responsibility of observational data providers ~~suppliers~~/Members. A more suitable method of communication with data users might be considered as a future responsibility of an RWC, possibly automated through enhancements of the Incident Management System (IMS) webtool.

Figure 2 shows the Functions of Regional WIGOS Centres ~~WDQMS processes~~.

Figure 2. Functions of Regional WIGOS Centres~~WDQMS processes~~

~~2. QUALITY MONITORING PRACTICES~~

Data quality monitoring practices ~~should~~ focus ~~initially~~ on the assessment of the performance of the ~~surface land observing~~ stations of GOS⁶¹ and GBON⁶² against a set of targets, ~~defined in Annexes 1-4~~:

1. Performance figures in terms of quantities (for example, number of observations provided on a daily basis, compared to the required and expected number of observations to be ~~ingested to~~ ~~exchanged internationally via~~ WIS/GTS according to the schedule outlined by WMO Members for routine dissemination from stations listed in OSCAR/Surface);
2. Performance figures in terms of timeliness indicating the delay of data during data transmission between the observation time at the site of a Member and the reception of the data by the users via the Global Telecommunication System (GTS)/WIS (in the NMHS database);
3. Quality indicators of the observed variables, which provide a measure of accuracy (for example, measurement uncertainty, usually in the form of bias (calculated as a measure of trueness and thereby being an estimate of systematic error), standard deviation (calculated as a measure of precision and thereby being an estimate of random error) and number (or percentage) of incidental gross errors);
4. Quality indicators for metadata, which are essential for interpretation and use of the data (timestamp, station positions and station elevation) and other information, and which are necessary for appropriate data management and usage;
5. Results of data quality control processes, including error and consistency checking ~~of across various meteorological bulletins in Traditional Alphanumeric Code (TAC) or Table Driven Code Form/Binary Universal Form for the Representation of meteorological data (TDCF/BUFR) and the detection and elimination of discrepancies in TAC and BUFR bulletins.~~

⁶¹ See WDQMS Users Guide: <https://confluence.ecmwf.int/display/WIGOSWT/3.2+Data+quality>

⁶² See GBON requirements in the Guide to WIGOS (WMO-No. 1165, Chapter 11)

2. METADATA MANAGEMENT

2.1 Links between OSCAR/Surface and WDQMS webtool

The WDQMS webtool retrieves metadata information from OSCAR/Surface on a daily basis. For example, the availability maps are generated in near-real time by comparing the observations received by the NWP Centres against the schedules retrieved from OSCAR/Surface. Therefore, if the metadata has been updated today, tomorrow's maps should reflect that change. If a new station is added to OSCAR/Surface, it should appear on the WDQMS availability map on the next day. If that does not happen, it means that some fields may have not been correctly populated in OSCAR/Surface and this needs to be reported to the RWCs.

In the case of Global Observing System (GOS) surface and upper-air stations on land, the monitoring results of the actual performance of each station, produced by the WDQMS webtool, are provided to OSCAR/Surface and displayed as "Assessed reporting status".

2.2 Evaluation of WIGOS Metadata

Station metadata: the received observations are more than the required number of bulletins as determined by the observing schedule for international exchange according to OSCAR/Surface for GOS stations and GBON requirements; or the station is not expected to report during the period according to OSCAR/Surface schedule, yet data was received. A station may also report data but is not registered in OSCAR/Surface. Such stations can only be identified by their Traditional Station Identifier (TSI), WIGOS Station Identifier (WSI) or location in the WDQMS webtool.

It is important to note that RWCs are not responsible for correcting station metadata.

3. QUALITY MONITORING PRACTICES

3.1 Quality monitoring categories

To run ~~GOS~~ WIGOS observing networks effectively and to ensure the ~~system~~ observational data is delivered according to the required ~~elements level of common user needs~~, the following three main categories have been identified to be most important for measuring the performance of ~~the system~~ an observing network against a set of targets:

- **Data availability:** total number of meteorological bulletins ~~(TAC/BUFR)~~ received during a defined period (for example, 24 hours) compared to the required number of bulletins as determined ~~by the observing schedule to be ingested to GTS for international exchange~~ according to ~~WIS for stations/platforms that are listed in~~ OSCAR/Surface ~~for and affiliated to GOS stations and according to requirements for GBON stations.~~
- **Timeliness:** delay between the nominal observation time of a particular observation message issued at an ~~observing station Member~~ (site) and the reception time at the user database of this message received via GTS/WIS. The nominal observation time of a SYNOP message is typically HH+00. Hence, the timeliness of a SYNOP message is calculated by computing the delay between the reception time of the observations' database time stamp of the WIGOS Monitoring Centres and HH+00.
- **Accuracy/Quality:** combining trueness and precision as outlined in the International Organization for Standardization (ISO) standard ISO 5725 (see Annex 4.3), mainly derived from "observation minus background" (O-B) NWP results from Global NWP Centres for parameters such as ~~atmospheric~~ pressure, air temperature, wind and relative humidity observations. For some parameters such as precipitation, Global NWP Centre forecast

skills might not be good enough to allow usage of forecasts as reference in the procedure for determining observation accuracy. Hence, different approaches to determine accuracy may have to be considered for particular parameters of GOS networks. For example, large errors in pressure observations derived from O-B NWP results might be caused by incorrectly reported station metadata (station position, station or barometer height) that are either edited in OSCAR/Surface or encoded in BUFR bulletins. In this case, the RWC will contact the [WDQMS NFP of the](#) Member operating the station and issuing bulletins via GTS/WIS to check and update station metadata information in OSCAR/Surface or in BUFR bulletins. ~~Note that RWCs are not responsible for checking and correcting station metadata.~~

Further issues and incidents might be identified during the quality monitoring and evaluation process. This should result in the initiation of the incident management procedure (IMP) in the same way as for the three main categories. Issues may include:

- Suspicious values of particular variables (consistency check) according to the daily monitoring reports provided by the WIGOS Monitoring Centres.
- Discrepancies in the total number of TAC and BUFR bulletins compared to the number of bulletins expected to be ~~ingested~~ [exchanged internationally through WIS/GTS](#) according to [WIS OSCAR/Surface \(for GOS stations\) or as indicated in the Manual on WIGOS \(WMO-No. 1160\) for GBON stations.](#)
- Encoding issues mainly in BUFR messages (due to wrong use of descriptors, missing descriptors, incorrect TAC to BUFR conversions, etc.), although, in many cases, encoding issues cannot be explicitly identified and highlighted by the WIGOS Monitoring Centres during the automated quality monitoring process. Hence, RWCs have to consider that low performances in availability might be caused by encoding errors and thus must be able to access an observations database to check bulletins distributed via GTS/WIS.

23.2 Performance targets

To identify underperforming stations, targets for the three main categories described above have to be agreed. Station performances will be compared to these targets. Whenever a station shows non-compliance with one of the three categories, an IMP should be initiated as described in Chapter [45](#).

The WDQMS performance targets take into account the following:

- WMO guidance, especially from the ~~Commission for Basic Systems Open Programme Area Group on Integrated Observing Systems – Inter Programme Expert Team on Observing System Design and Evolution~~ [Guide to WIGOS \(WMO-No. 1165\)](#)
- WMO global NWP application area requirements as indicated in the OSCAR/Requirements database
- OSCAR/Surface, which is the WMO official repository of metadata on surface-based WIGOS observations
- WIS, which is the single coordinated global infrastructure responsible for telecommunications and data management functions
- Other national and regional requirements
- Constraints of Members, in particular NWP centre data assimilation cut-off times and remote data communications issues leading to time delays in data submission (for example, due to the use of satellite transmission windows)

All targets regarding data availability refer to the ~~percentage number~~ of observations received from the different GOS observing system/networks in relation to the number of observations expected to be ~~ingested-exchanged internationally to WIS/GTS~~ according to the observation schedules defined in WIS. As OSCAR/Surface is the WMO official repository of metadata on surface-based WIGOS observations, a direct link to WIS should be established, to ensure that OSCAR/Surface provides information on the general capability of measuring a particular parameter at a site and Member commitment to ingest corresponding bulletins to ~~WIS/GTS~~. For example, it might be the case that a station measures air pressure hourly but is committed to WIS to ingest SYNOP message to GTS every 3 ~~hours~~. If the information on ~~international exchange via WIS/GTS~~ commitment is not captured in OSCAR/Surface, the data availability monitoring would not show appropriate results.

All targets regarding timeliness refer to the time delay between the nominal observation time and its reception time at user databases. Targets relate to the percentage of data received, not expected. This means that if, for a particular station, no bulletins were ingested to ~~WIS/GTS~~, the data availability performance will drop for this station, ~~but this data outage should not affect the timeliness performance statistics for the station. Currently, the WDQMS webtool offers no functionality to monitor timeliness. Hence, RWCs may use other means to monitor this category.~~

All ~~measurement-uncertainty-quality~~ targets are stated as targets for standard deviation (estimate of random errors) as a measure of observation precision. ~~Biases should be avoided; that is, related targets are close to zero. Observations should be made in such a way that any biases (estimates of systematic errors) of measurement systems form only a small part of the measurement uncertainty.~~ It is important to note that all observations are considered in the monitoring and evaluation functions, including outliers or apparently wrong encodings. The goal of WDQMS is to ensure ~~GOS is the observing networks are~~ operating and delivering data to the required standards; it thus needs to identify all types of issues and incidents. If continuously occurring large outliers were neglected in the monitoring and evaluation functions, RWCs would never initiate an incident rectification process within the incident management function and thus the situation would not improve over time. As a consequence, outliers (caused by gross errors) should not be filtered out prior to calculation of bias and standard deviation if no separate statistic about number of gross errors is provided. ~~Hence, the WDQMS webtool shows if an NWP Centre rejected the data or blacklisted the station.~~

Targets within these guidelines mainly use "threshold" requirements. However, in the evolution of WDQMS and the tasks for RWCs, "breakthrough" requirements and "goals" might be introduced as descriptors. The general definitions of these terms according to WMO RRR are ~~described in the Manual on WIGOS (WMO-No. 1160) and published in OSCAR/Requirements database⁶³:~~

~~-----"Threshold" is the minimum requirement to be met to ensure that data are useful.~~

~~-----"Goal" is an ideal requirement above which further improvements are not necessary.~~

~~-----"Breakthrough" is an intermediate level between "threshold" and "goal", which, if achieved, would result in a significant improvement for the targeted application; the breakthrough level may be considered as optimal, from a cost-benefit point of view, when planning or designing observing systems~~

Whenever the WDQMS performance targets are revised, the targets defined in WMO RRR for the global NWP application area are taken into account. The WDQMS performance targets ~~for surface land stations and upper air land stations used by the WDQMS webtool~~ are described in ~~Annex 1 WDQMS User Guide;~~ ~~for GBON stations the performance targets are described in the~~

⁶³ <https://space.oscar.wmo.int/observingrequirements>

Guide to WIGOS (WMO-No. 1165) which also contains links to the relevant IDs in the requirements for the global NWP application area.

23.3 Web tools and automated daily quality monitoring reports

WIGOS Monitoring Centres should produce and make available automated data availability and quality monitoring reports on a daily basis. The format for monitoring reporting of observations, such as surface land stations and upper-air land stations provided by Global NWP Centres for the WDQMS webtool is described in Annexes 5 and 6 of this document the WDQMS User Guide⁶⁴. These reports might be provided on a 3 or 6 hours basis or on a daily accumulated/averaged basis. The reports should be made available and maintained on the Internet in appropriate WDQMS web tools (for example, the WIGOS quality monitoring web tool, currently a prototype (<http://128.65.196.37/wdqm/>) or the WMO Quality Monitoring Portal operated by EUMETNET (<https://eucos.dwd.de/ravi/>) or other monitoring webtools to display the data availability, timeliness of data and accuracy/quality/measurement uncertainty of observations (for example, derived from observation minus first guess/background fields (O-B results) of Global NWP Centres for surface land stations and upper-air (radiosonde) land stations on land, over a period of time).

The key/official webtool used by RWCs is the WDQMS webtool, which is a resource developed by WMO to monitor the performance of WIGOS observing components. The current operational version of the webtool monitors the availability and/or quality of observational data based on near-real-time NWP monitoring information for surface and upper-air land observations of the GOS/GBON and monthly monitoring information of GCOS, based on data from the WIGOS Monitoring Centres. More WIGOS components are expected to be added to the webtool in the future. The WDQMS webtool undergoes continuous review and development to better support the performance monitoring process. The WDQMS webtool provides daily and monthly aggregations of the monitoring information.

RWCs should use these web tools to fulfil their task of daily quality monitoring and evaluation, and to be in a position to identify issues and raise them as incidents if the issues persist. The webtools o further assist RWCs in their daily quality monitoring, the web tools should compile and provide daily/ and monthly summaries, based on the files produced by the WIGOS Monitoring Centres (for example, the quantity or volume of land-based observations reported on WIS/GTS compared to the required (and thus expected), the number of reports according to WIS, the average daily timeliness of the data and daily averaged measurement uncertainty quality results from the different WIGOS Monitoring Centres). The web tools should allow continue to evolve to provide RWCs and NFPs with useful functions based on their needs, such as various statistics to be and a filter ed function, to display, for example stations by Member, or to display only those stations that exceed targets on data availability, timeliness or measurement uncertainty (bias, standard deviation, mean vector difference (MVD) and root mean square vector difference (RMSVD)) quality and by station metadata.

RWCs should be able to access the entries in the OSCAR/Surface metadata database (<https://oscar.wmo.int/surface>). Although it is not the task of RWCs to check and correct station metadata in OSCAR/Surface, during the quality monitoring and evaluation process, it might turn out that amendments in the entries of OSCAR/Surface metadata database will be required. This is particularly the case regarding barometer or station heights and station positions recorded in OSCAR/Surface or encoded in the BUFR messages, if large measurement uncertainty (bias) quality errors in pressure observations occur. If this happens, RWCs will need to ask the WDQMS NFP of the corresponding Member to review the entries in OSCAR/Surface or in BUFR encoding and to monitor the successful incident rectification. A

⁶⁴ For Land-based surface observations: <https://confluence.ecmwf.int/display/WIGOSWT/6.1+Land-based+surface+observations>, for upper-air land observations: <https://confluence.ecmwf.int/display/WIGOSWT/6.2+Upper-air+land+observations>

detailed background and understanding of the defined observing schedule of the monitored stations are essential to operate an effective WDQMS.

34. DATA QUALITY MONITORING AND EVALUATION

34.1 Resources

Details on required staff competences and technical resources to establish and operate a Regional WIGOS Centre are described in chapter 8 of the Guide to WIGOS (WMO-No. 1165).

3.1.1 Staff competences

To effectively run the evaluation function, RWCs should be staffed by suitable technical/scientific officers that have:

1. Detailed understanding of the surface-based system of GOS and its operation (to be expanded in future to other WIGOS observing components, although the functions might be split among multiple RWCs);
2. Sound knowledge of meteorological observations and WMO codes, as well as skills in data analysis;
3. Skills and knowledge in quality management systems (in general), and incident management processes (in particular);
4. Skills and knowledge in communication and report writing.

The more challenging the requirements and thus the tasks, the more the skills and knowledge levels of the staff might have to be increased or potentially other experts have to be consulted.

3.1.2 Technical resources

RWCs should have access to information, data and tools that support quality evaluation processes. As a minimum, these include:

1. Observation bulletins in TAC and BUFR received via GTS and stored in an operational observations database;
2. OSCAR/Surface;
3. Relevant automated monitoring statistics provided via the web tools described in section 2.3 and other global, regional and national monitoring reports that might be of use for the quality evaluation process;
4. Quality monitoring results and statistics in a form that allows flexible and rapid rendering of the data for analysis, comparison, plotting, etc.;
5. Data analysis applications and tools.

3.1.3 Duties

RWCs should have the resources to run the incident management function, through an appropriate incident management system (IMS) for the registration and follow-up of issues identified in the quality evaluation process.

RWCs should utilize the results of quality evaluation and incident management practices to identify systemic issues that might be addressed to improve the performance of stations through proposed modification or changes to processes and procedures.

Results of quality evaluation analyses and resulting changes to the observing system should be notified, recorded and documented in line with national, regional and WMO quality management standards and recommended procedures.

34.2 Daily tasks

RWCs should evaluate the performance of GOS stations ~~(for example, Regional Basic Synoptic Network surface and upper air land stations and stations)~~ and of GBON stations of ~~countries Members~~ under their responsibility. This should be done on a daily basis ~~at least on working days~~, by reviewing the automated quality monitoring reports received from the WIGOS Monitoring Centres ~~on the WDQMS webtool and other monitoring portals for supplementary information~~. RWCs should evaluate the performance of the stations within their scope ~~every day in the morning hours daily~~ as follows:

~~21. Be aware~~ Take into account that the results from various WIGOS Monitoring Centres might differ and hence initiate an incident management process only if most WIGOS Monitoring Centres show similar results (for example, data from the same station is missing in most Global NWP Centres). The following differences might be recognizable when using quality monitoring reports of different Global NWP Centres (see also WDQMS user guide, 5. NWP Centre aggregation (Monitoring Centre)):

- (a) ~~When a station reports in format types TAC and BUFR, some Global NWP Centres consider only one of those types, while other Global NWP Centres consider both types;~~
- (b) ~~Monitoring reports of a Global NWP Centre contain only the data that passed the quality control prior to data assimilation, and therefore part of the available data that was deemed poor quality was filtered out and not available for data assimilation, whereas monitoring files of another Global NWP Centre may contain the data deemed as poor quality and that were rejected and/or blacklisted;~~
- (c) ~~Monitoring reports of a Global NWP Centre might not contain any information about a particular station if the variable in question (for example, pressure observation) was not reported, whereas monitoring reports of other Global NWP Centres might contain a result for this station if a message in general was available but the particular variable was missing;~~
- (d) ~~A Global NWP Centre assimilates geopotential height from high-altitude stations, whereas another Global NWP Centre does not assimilate geopotential height;~~
- (e) ~~Due to technical problems at a Global NWP Centre, subsidiary data availability, timeliness or quality results provided to the RWC are not comparable to data available on WIS/GTS.~~

~~32. In the case of any non-compliance of a particular station, consider raising an incident ticket according to the procedure described in section 45.2 and to item 6 below. When several stations of a Member show the same non-compliance, one incident ticket might be raised for a group of stations.~~

~~43. Check the web-tools for whether the station started reporting, if the station did not report any data the previous day. This is especially important in the case of non-compliance according to 1(a) above.~~

~~54. Check the performance of the corresponding station and follow the same quality evaluation processes if an issue has been reported to the RWC by a user (for example, a WIGOS Monitoring Centre, a Global NWP Centre or a Member of an RA).~~

~~65. Check the status of issues identified in previous days, in addition to checking station performances the previous day. Stations with identified issues should be checked again as to whether the performance improved (for example, the station started reporting again, did the station reported as many reports as required according to OSCAR/Surface observing schedule again, the data started arriving without delays again or quality results~~

of observations have improved, again and therefore remained within the agreed targets on a daily average):

- (a) If an issue continued for 5 (or more) days in a row, an incident management process (IMP) as described in Chapter 45 should be initiated by raising a ticket in the Incident Management System (IMS) webtool which is assigned to the WDQMS NFP of the Member operating the station (section45.2);
- (b) If an issue "disappeared" within these 5 days because the performance of the station improved again, no formal incident process has to be initiated and the issue will be closed (section45.2).

76. Monitor the status of raised incident tickets on a daily basis, and ensure that the Member to which an incident has been reported:

- (a) Confirmed the reception of a new incident ticket;
- (b) Provided an appropriate action proposal containing details of the cause of the incident, proposed actions and a timeline to resolve the incident;
- (c) Provided regular updates whenever possible, at least once every month;
- (d) Reported on incident rectification.

87. After the WDQMS NFP of the Member has reported incident rectification, check the improvement in performance of the station in question, confirm successful rectification of the incident, and incident ticket.

98. Ask the WDQMS NFP of the Member operating the station to investigate and, if needed, to update the entries in OSCAR/Surface accordingly, in cases where it is suspected that an issue or incident was caused by incorrect metadata in OSCAR/Surface.

9. "Won't fix" and Escalation: The RWC may update the status of a ticket to "Won't fix" when the WDQMS NFP finds that incident cannot be rectified because no immediate action can be taken. The ticket with "Won't fix" status can be returned to status "In progress" when the WDQMS NFP has indicated that corrective actions can be taken to rectify the incident. If there is no confirmation from WDQMS NFPs, the RWC may escalate the incident via the WMO Secretariat, by changing the ticket status to "Escalated". WMO Secretariat may escalate the issue to a higher level, e.g. bring it to the attention of the PR of the Member if there is no feedback from WDQMS NFP. It is recommended that the RWCs make various efforts to contact the WDQMS NFPs before deciding to escalate a ticket.

4.2.1 Near real-time NWP monitoring of the Global Observing Systems networks

4.2.1.1 Surface land observations (global NWP) – Availability, Timeliness, Quality and Station metadata

1. Review the available WDQMS web-tool outputs (maps and graphics) and other quality monitoring reports to identify stations that show any non-compliance concerning data availability, timeliness, ~~and measurement uncertainty (bias, standard deviation, MVD and RMSVD)~~ quality and station metadata regarding the WDQMS performance targets (Annex 1). Reasons for non-compliance might be:
 - (a) The station did not report any data ~~yesterday~~ since the previous day (category: data availability) – black dot in WDQMS webtool;
 - (b) The total number of reports is significantly lower than the expected number of observations as defined in the observing schedule in WIS and OSCAR/Surface (category: data availability) – orange/red dot in WDQMS webtool;

- (c) The total number of reports is higher than the expected number of observations defined in the observing schedule for international dissemination in OSCAR/Surface (category: metadata) – pink dot in WDQMS webtool;
- (d) The station is not expected to send reports during the period according to OSCAR/Surface schedule (category: metadata) – grey dot in WDQMS webtool;
- (e) The station send reports but there is no corresponding station ID (not registered) in OSCAR/Surface – yellow dot in WDQMS webtool.
- (ef) The data ~~arrived~~ received with a significant delay, which may lead to a situation where data could not be used in near-real-time applications, for example, for nowcasting purposes (category: timeliness) – not quantified in WDQMS webtool currently;
- (dg) The daily averaged ~~measurement uncertainty statistics (bias, standard deviation, MVD and RMSVD)~~ quality results received from WIGOS Monitoring Centres (for example, derived from O-B results from Global NWP Centres) exceed the WMO threshold requirements concerning a particular variable or variables (category: ~~accuracy~~ quality) – yellow/orange/red dot in WDQMS webtool.

- ~~2. Be aware that the results from various WIGOS Monitoring Centres might differ and hence initiate an incident management process only if most WIGOS Monitoring Centres show similar results (for example, data are missing in most Global NWP Centres). The following differences might be recognizable when using quality monitoring reports of different Global NWP Centres:~~
 - ~~(a) When a station reports in format types TAC and BUFR, some Global NWP Centres consider only one of those types, while other Global NWP Centres consider both types;~~
 - ~~(b) Monitoring reports of a Global NWP Centre contain only the data that passed the quality control prior to data assimilation, and therefore part of the data available that was deemed poor quality was filtered out and not available for data assimilation, whereas monitoring files of another Global NWP Centre contain even the data deemed as poor quality and that were rejected and/or blacklisted;~~
 - ~~(c) Monitoring reports of a Global NWP Centre might not contain any information about a particular station if the parameter in question (for example, pressure observation) was not reported, whereas monitoring reports of other Global NWP Centres might contain a result for this station if a message in general was available but the particular parameter was missing;~~
 - ~~(d) A Global NWP Centre assimilates geopotential height from high-altitude stations, whereas another Global NWP Centre does not assimilate geopotential height;~~
 - ~~(e) Due to technical problems at a Global NWP Centre, subsidiary data availability, timeliness or measurement uncertainty results provided to the RWC are not comparable to data available on GTS.~~
- ~~3. In the case of any non-compliance of a particular station, raising an incident ticket according to the procedure described in section 4.2. When several stations of a country show the same non-compliance, one incident ticket might be raised for a group of stations.~~
- ~~4. Check the web tools for whether the station started reporting, if the station did not report any data yesterday. This is especially important in the case of non-compliance according to 1(a) above.~~
- ~~5. Check the performance of the corresponding station and follow the same quality evaluation processes if an issue has been reported to the RWC by a user (for example, a WIGOS Monitoring Centre, a Global NWP Centre or a Member of an RA).~~
- ~~6. Check the status of issues identified in previous days, in addition to checking yesterday's station performances. Stations with identified issues should be checked again as to whether the performance improved (for example, did the station start reporting again, did the station report as many reports as required according to Volume C1 and according to the WIS and OSCAR/Surface observing schedule again, did the data start arriving without~~

~~delays again or did the measurement uncertainty of observations decrease, that is improve, again and therefore remained within the agreed targets on a daily average);~~

~~(a) If an issue continued for 5 (or more) d for surface land stations or radiosonde stations, an IMP as described in Chapter 4 should be initiated by defining a unique incident ticket number and by informing the national contact of the country (section 4.2 and Annex 7);~~

~~(b) If an issue “disappeared” within these 5 d because the performance of the station improved again, no formal incident process has to be initiated and the issue will be closed (section 4.2 and Annex 7); in this case, the issue reporter should be informed about the improved performance and the closure of the issue.~~

~~7. Monitor the status of raised incident tickets on a daily basis, and ensure that the country to which an incident has been reported:~~

~~(a) Confirmed the reception of a new incident ticket;~~

~~(b) Provided an appropriate action proposal containing details of the cause of the incident, proposed actions and a timeline to resolve the incident;~~

~~(c) Provided weekly updates and even “no change” reports;~~

~~(d) Reported on incident rectification.~~

~~8. Close an incident ticket after the national contact of the country has reported incident rectification, check the improvement in performance of the station in question, confirm successful rectification of the incident, and inform issue reporters about successful incident rectification and closure of the report.~~

~~9. Ask the national contacts of the country operating the station to investigate and, if needed, to update the entries in OSCAR/Surface accordingly, in cases where it is suspected that an issue or incident was caused by incorrect metadata in OSCAR/Surface.~~

4.2.1.2 Upper-air land observations (global NWP) – Availability, Quality and Station metadata

~~1. Review the available webtool outputs and quality other monitoring reports to identify stations that show any non-compliance concerning the received upper-air (soundings) observations and quality results regarding the WDQMS performance targets. Reasons for non-compliance might be:~~

~~(a) The station did not report any data the previous day (category: data availability) – black dot in WDQMS webtool;~~

~~(b) The total number of daily reports is significantly lower than the expected number of soundings as defined in the observing schedule for international dissemination in OSCAR/Surface (category: data availability) – red dot in WDQMS webtool;~~

~~(c) The total number of daily reports is higher than the expected number of soundings as defined in the observing schedule for international dissemination in OSCAR/Surface (category: metadata) – pink dot in WDQMS webtool;~~

~~(d) The station reported data but has completeness issues (category: availability) – orange dot in WDQMS webtool;~~

~~(e) The station is not expected to report during the period according to OSCAR/Surface schedule (category: metadata) – grey dot in WDQMS~~

~~(f) The station reported data but there is no corresponding station ID (station not registered) in OSCAR/Surface (category: metadata) – yellow dot in WDQMS webtool;~~

~~(g) The data received with a significant delay, which may lead to a situation where data could not be used in near real time applications, for example, for nowcasting purposes (category: timeliness) – not quantified in WDQMS webtool currently;~~

~~(h) The daily averaged quality results received from WIGOS Monitoring Centres (for example, derived from O B results from Global NWP Centres) exceed the WMO~~

threshold requirements concerning a particular variable or variables (category: quality) – yellow/orange/red dot in WDQMS webtool.

4.2.2 Global Basic Observing Network (GBON)

4.2.2.1 Surface land observations – Station compliance (Availability of surface land observations (GBON))

1. Review the available webtool outputs and other quality monitoring reports to identify stations that show any non-compliance concerning data availability.

----- Reasons for non-compliance might be:

(a) The station did not report any data the previous day (category: data availability) – black dot in WDQMS webtool;

(b) The total number of reports is significantly lower than the expected number of observations as defined in the observing schedule for international dissemination in OSCAR/Surface (category: data availability) – orange/red dot in WDQMS webtool.

2. If a station did not meet the GBON compliance criteria for surface land observations for two or more days, an IMP as described in Chapter 5 should be initiated by raising a ticket in the Incident Management System which is assigned to the WDQMS NFP of the Member operating the station (section 5.2);

4.2.2.2 Upper-air land observations – Station compliance (Availability of upper-air land observations (GBON))

1. Review the available webtool outputs and other quality monitoring reports to identify stations that show any non-compliance concerning data availability.

----- Reasons for non-compliance might be:

(a) The station did not report any complete sounding the previous day (category: data availability) – black dot in WDQMS webtool;

(b) The station reported only one complete sounding the previous day (category: data availability) – orange dot in WDQMS webtool;

2. If a station did not meet the GBON compliance criteria for surface land observations for two or more days, an IMP as described in Chapter 5 should be initiated by raising a ticket in the Incident Management System which is assigned to the WDQMS NFP of the Member operating the station (section 5.2);

4.3 Monthly tasks

4.3.1 Global Basic Observing Network (GBON)

4.3.1.1 Surface land observations – Station compliance (Availability of surface land observations (GBON))

1. Review the available webtool outputs and quality monitoring reports to identify stations that show any non-compliance concerning data availability. Reasons for non-compliance might be:

(a) The station reported less than 10 days for the month (category: data availability) – white dot in WDQMS webtool;

(b) The station did not report any data for the month (category: data availability) – black dot in WDQMS webtool;

(c) ~~The total number of reports is significantly lower than the expected number of observations for the month (category: data availability) – orange/red dot in WDQMS webtool.~~

2. ~~If a station did not meet the GBON compliance criteria for surface land observations, an IMP as described in Chapter 5 should be initiated by raising a ticket in the Incident Management System which is assigned to the WDQMS NFP of the Member operating the station (section 5.2);~~

~~4.3.1.2 Upper-air land observations – Station compliance (Availability of upper-air land observations (GBON))~~

1. ~~Review the available webtool outputs and quality monitoring reports to identify stations that show any non-compliance concerning data availability. Reasons for non-compliance might be:~~

(a) ~~The station did not report any complete soundings for the month (category: data availability) – black dot in WDQMS webtool;~~

(b) ~~The total number of complete soundings is significantly lower than the expected number of soundings for the month (category: data availability) – orange/red dot in WDQMS webtool;~~

2. ~~If a station did not meet the GBON compliance criteria for surface land observations, an IMP as described in Chapter 5 should be initiated by raising a ticket in the Incident Management System which is assigned to the WDQMS NFP of the Member operating the station (section 5.2).~~

4.5. INCIDENT MANAGEMENT PROCEDURE

Figure 3 illustrates the Incident Management Process (IMP) to formally record issues, report incidents, follow up on actions and correct problems.

Figure 3. Incident Management Process (IMP)

4.5.1 Responsibilities

The success of an IMP depends on clear identification of roles and responsibilities. These are defined below for each of the six IMP steps illustrated in Figure 3.

It is essential to have clearly defined contacts for each ~~country monitored by the RWC of those WDQMS NFP who is~~ responsible for ensuring a corrective action is taken once requested by the RWC. ~~The se contacts could be the nominations and updates to NFP for WDQMS, as well as the NFP for OSCAR/Surface or the NFP for WIGOS listed are made in the WMO Country Profile Contacts Database.:~~ <https://contacts.wmo.int/>.

~~It would be beneficial to have generic email addresses available for each country, which are accessible by national contact points, to ensure that Newly created/updated tickets should be distributed to several persons inside the concerned Member can to be informed about any incident/progress simultaneously. Responsibility for solving the incident raised by the RWC, by issuing an incident ticket, lies entirely with the country or data provider operating the station the supervising organization of the concerned station within the Member (data provider).~~ The responsibility of the RWC is to supervise the status of the incident and its rectification, and to escalate the incident to a higher level if necessary. Communicating issues to ~~data users WDQMS NFPs, i.e. initiating an IMP (B)~~ is not necessary unless they remain for some time or significantly affect users. ~~An The~~ IMS is designed for routine operations, not ~~for~~ catastrophic events.

45.2 Steps

To ensure efficient operation of an IMS, an RWCs should utilize a standard ticket template, use the IMS webtool for raising, tracking and assisting in resolving an incident according to the different various IMP steps shown in Figure 3. An example of such an incident ticket is provided in Annex 7.

The incident tickets and all correspondence between the RWC and the WQMS NFP of the countries Members under its responsibility will be uploaded and maintained on an appropriate website or ticket system tool that can be easily accessed by all organizations involved the IMS webtool. The RWC should create and keep updated on The IMS allows the RWC to extract incidents tickets summaries, preferably automatically for their affiliated Members. The ticket summary will aid communication during all stages of the IMP, to ensure that all the necessary information is made available for monitoring and documenting the status of the raised incident. RWCs and WQMS NFPs may refer to any user manuals on the Incident Management System that WMO Secretariat make available.

Most Members might may operate their national IMSs and incident management systems with software of their own but need to respond to issues raised by RWC in the IMS webtool. RWCs will generally use only their own the IMS software webtool to initiate and supervise tickets for incidents identified in when performing the evaluation function. If a Member intends to maintain and supervise the incident ticket within their national IMS, the RWC should be informed about the national ticket number.

45.2.1 Issue identification (A)

Issue identification is part of the evaluation function because it is a result of the daily monitoring activity of a station's performances. Generally, RWCs will be responsible for monitoring network performances on a daily basis and for identifying issues, although relevant participating organizations, such as NMHSs and Global NWP Centres, are themselves encouraged to use the IMS webtool to report non-compliances to RWCs if they become aware of an issue.

When an NMHS, a WIGOS Monitoring Centre or a Global NWP Centre identifies an issue on data availability or timeliness of a particular station/several stations or on measurement uncertainty quality by showing high O-B results, the RWC should be informed. Once an issue has been reported to the RWC or has been identified by directly, e.g. via email, in which case the RWC, the issue will be documented the issue by creating a new ticket.

Each ticket should have a unique number-description-ID ("Summary" field in IMS webtool) that consists of five parts [ccc-ID-nnnnn-i-yyyymmdd]:

-----ccc: a three character country code, for example "KEN"

-----ID (for example, WMO ID or WIGOS identifier in the future)

-----nnnnn: a sequential number (for every new ticket opened), for example "01204"

-----i: a figure indicating if the issue has been raised as an incident (using "1") or not ("0")

-----yyyymmdd: the year (yyyy), month (mm) and day (dd) when the ticket was created

Example: KEN-63688-005-0-20160712

a set of alphanumeric characters with the following format:

ddmmyyyy-Member-WIGOS_module-period-station/location-network type-monitoring category-issue, where:

- "ddmmyyyy" it the day, month and year when ticket is created
- Member: Member operating the station
- WDQMS webtool module: NWP or GBON
- Period: daily or monthly
- Station/location: station name
- Network type: Surface or Upper-air, GBON
- Monitoring category: availability, quality, metadata
- Issue: keyword of the issue

Example: "04032020-Chile-NWP-daily-Tamuco-Surface-Quality-suspicious pressure values" means that on March 4, 2020, a ticket related to NWP daily for surface land station, air pressure data quality in Tamuco Station in Chile was created.

If more than one station of a Member show the same non-compliance, the station/location text could be used to describe such cases, e.g. by inserting "three stations" or just "stations".

~~RWCs should insert the following information in part A of the ticket:~~

- ~~---- Date and time when the ticket describing an issue was created~~
- ~~---- Station details, in particular WIGOS station identifiers and network type, station name and WMO Member~~
- ~~---- Name of the person and organization that raised the issue, including contact details (email address)~~
- ~~---- Full description of the issue, including the dates the issue was first identified, characteristics of the issue, category of incident type (for example, availability and timeliness of data or quality (accuracy/measurement uncertainty) of data); instrumentation identified as the source of the issue and, if possible, application areas affected by the issue~~

~~RWCs should add the issue to the ticket summary by setting "i" in the incident ticket number to "0" at this stage, and set the ticket status to open.~~

RWCs should also monitor each issue ~~at surface land stations and upper-air (radiosonde) land from observing stations~~ over 5 working days in a row for near real time (NRT) monitoring and 2 days for GBON monitoring before raising the issue into an incident and initiating the incident management process (part B of the ticket).

4.5.2.2 Issue raised as incident (incident process initiation) (B)

RWCs will be responsible for initiating the incident management process. Once an issue (part A) has been deemed serious enough to be raised as an incident (for example, if the identified issue lasted longer than 5 working days for NRT NWP monitoring), a notification to the WDQMS NFP of the country Member is required by converting the ticket stats from "Open" to "Incident" on the IMS webtool. ~~This will involve the following tasks and additions to the ticket in part B:~~

- ~~----- Convert the issue ticket number into an incident ticket number (which will be used in all future correspondence)~~

~~-----Add date and time of incident raising (process initiation)~~

~~-----Add details of the evaluation results to document why the RWC raised an incident (for example, reported data outage of a particular station was monitored via the web tools and the outage was still ongoing)~~

~~-----Prioritize the level assigned to the incident (low, medium, high and very high; see details in Annex 2)~~

~~-----Bring the problem to the attention of the country in question, making the ticket available to them via the NFP and requesting the relevant NFP to take corrective action as rapidly as possible~~

~~-----Add the new incident ticket number ("Incident ID") to the ticket summary and update the date, status and other relevant parts accordingly~~

If the identified issue has been monitored over the defined periods and the issue has been resolved (or has disappeared) without further action taken by the RWC, ~~this shall be highlighted by adding "No incident process required" to the ticket. The issue ticket shall either be closed in part F, or the performance of the station will be further monitored over the next 2-d before deciding to finally close the issue or to raise an incident, the ticket should be closed.~~ RWCs may choose to further monitor the performance of the station for another 2 days before closing the issue. If there is a significant incident (for example, SYNOP data of all stations of a particular ~~countryMember are missing on WIS/GTS), data users should be informed about the incident and informed again after successful incident rectification (see part F) the issue can be converted to an incident immediately so that the WDQMS NFP can follow-up accordingly.~~ Annex 1 shows priority levels for some frequent issues.

45.2.3 Receipt confirmation (C)

As soon as the WDQMS NFP of the ~~countryMember~~ has received the incident ticket, ~~with the unique incident number from the RWC, actions shall be will~~ taken ~~actions~~ to investigate the cause of the incident and to find a solution. Annex 32 shows some ~~incident~~ frequent issues, potential sources and corresponding actions to be taken. To make the RWC aware that the ~~countryMember~~ has taken over the task of following up the incident, ~~a receipt confirmation (part C) including date/time, name of recipient and potential comments should be added to the IMS ticket by the NFP. Part C of the incident ticket should be updated by the NFP, and the RWC should be informed about the update immediately. The RWC will then update the date, ticket status and part of IMS in the ticket summary of the country in question. Once a confirmation is received at the RWC, the ticket status should be set as "in progress" the WDQMS NFP should confirm receipt of the ticket through the "Comment" section of the ticket, in the IMS webtool. RWCs should reply to the acknowledgement received from the WDQMS NFP by updating the ticket status to "Under Investigation".~~

45.2.4 Action proposal (D)

As soon as the WDQMS NFP of the ~~countryMember~~ has identified the cause of the incident and found a solution, the WDQMS NFP should ~~alert-update~~ the RWC of the proposed actions by ~~adding the following information to the incident ticket in part D providing input under the "Comment" section of the concerned ticket:-~~

~~---- Date/time, name of NFP and details of proposed action including timeline to solve the incident and additional relevant comments~~

~~The incident ticket should be updated by the NFP, and the RWC should be informed about the update as soon as possible. The RWC will then update the date, ticket status and other relevant parts of the ticket summary of the country in question, preferably automatically.~~

validate the actions proposed by the WDQMS NFP and decide on whether to update the ticket status to "In Progress".

45.2.5 Incident status (E)

The WDQMS_NFP will regularly provide the RWC with summarized updates on the status of the incident (part E), as follows at least once every month, through the "Comments" section of the ticket, with the following information:

- Any significant action that has been taken and which should be recorded (for example, "incident ticket passed on to another department" or "cause of problem identified")

~~-----Routinely on a weekly basis (including "no change" reports)~~

~~-----At the moment when the incident has been rectified~~

~~NFPs should document the updates in the incident ticket by adding the following information in part E of the ticket:~~

- Activities undertaken to resolve the incident, by whom and when – essentially a work log of the actions undertaken during the lifetime of the ticket by adding date/time, organization and name of who is taking action, as well as the resulting status after each action

~~The IMS ticket should be updated at least once a week. The RWC will update the date, ticket status and other relevant parts of the ticket summary.~~

During part E of the IMP, it might be found that an incident cannot be rectified because no (immediate) action can be taken. In this case, the RWC should close the ticket and put the incident into the log of update the ticket to "Known problems" ("Won't fix" in the IMS webtool). One of the most likely known problems that might be identified at the beginning of RWC operations is that stations do not provide any data to WIS/GTS although they are listed as being operational and affiliated to GOS in OSCAR/Surface (so-called "silent stations").

It also might be the case that actions taken so far have been unsuccessful because the incident has been caused by a different activator cause. In this case, the RWC should may also close the former incident ticket and initiate a new incident process (part B) with a different incident description-ID.

45.2.6 Incident rectification (F)

If the incident has been rectified by the country and the WDQMS NFP should inform the RWC has been informed (part E) through the "Comments" section of the concerned ticket. ~~†~~ The RWC will check whether the incident ticket can be closed or has to be kept open due to ongoing non-compliance and underperformance compared to the WDQMS performance targets. In the case of ongoing non-compliance, the RWC will ask the WDQMS_NFP to take further actions, to be recorded in part E through the "Comments" section of the same ticket. If the RWC decides considers that the incident ticket has been rectified, the RWC will update the ticket status to "Resolved".

~~can be closed, the RWC will add to the ticket a closing date/time and the name of the RWC staff closing the ticket (part F), inform the NFP point and the issue reporter, and archive the ticket as a "resolved incident" in the ticket summary (that is, update the date and other relevant parts of the IMP, and set the ticket status to closed). Data users should be informed about successful incident rectification if required.~~

RWCs may choose to further monitor the performance of the station for another 2 days before closing the incident by updating the ticket status to "Closed".

The RWC can update the incident status with comments received from the WDQMS NFP via email or any other verifiable means of communication, including e.g. social media platforms. The RWC can also update the incident status should there be no comment from the Member, but the data availability, quality and metadata challenges have been resolved. The IMP will be completed once the last step has been carried out, that is, the ~~issue identification procedure~~ incident ticket shows evidence that the station performs correctly again.

45.2.7 Incident escalation procedure

~~In the unlikely event of non-response to the RWC incident reporting by a national contact of the country and the incident is sufficiently severe, the incident escalation procedure will state who should be contacted at a higher level. In the most severe cases, this may involve asking the WIGOS NFP and the WMO Country Profile Database NFP if needed to approach the Permanent Representative with WMO of the corresponding country asking for support.~~

~~The incident escalation procedure might also be initiated if long-lasting incidents are identified as "known problems" (problems that are ongoing and cannot be solved within the responsibility of the RWC and the NFP).~~

The WDQMS NFP should take all actions to resolve issues identified and to report the follow-up to the RWCs. There could be instances where the resolution of the issue requires coordination with other functions within the NMHS, such as:

- For metadata issues (e.g. in relation to barometer, station heights), the WDQMS NFPs may need to work with the OSCAR/Surface NFP to update the station metadata.
- For cases where the observation reports are sent but are not received by the WIGOS Monitoring Centres, the WDQMS NFP may need to work with the WIS Focal Point to engage with the respective GISC on possible transmission issues.
- For non-NMHS data the WDQMS NFP may need to work with the contact of the respective observational data provider.

If the issue still continues to be unresolved, the WDQMS NFP should escalate the issue internally within the NMHS for support in resolution. Such cases should be properly described in the comments section of the concerned ticket, in the IMS webtool.

There could also be situations when the issues identified by the RWCs cannot be resolved as the RWC is unable to contact with the WDQMS NFP (e.g. no WDQMS NFP is nominated or the NFP is not reachable). In cases where there is no response to the incident ticket by the WDQMS NFP of the Member and the incident is sufficiently severe the incident should be escalated to the WMO Secretariat who will reach out to the Permanent Representative (PR) with WMO of the respective Member via the WMO Regional Office of the respective RA.

In some cases where the RWC host Member and the concerned Member keep strong bilateral cooperation relationships, the RWC may consider contacting directly the PR of the Member, aiming at nominating or updating the contacts of the NFP for WDQMS. In such cases, the RWC should keep the WMO Regional Office informed.

The Incident escalation procedure to the PR might also be initiated if long lasting incidents are identified as "known problems" (problems that are ongoing and cannot be solved within the responsibility of the RWC and the WDQMS NFP).

56. QUALITY PERFORMANCE REPORTS

6.1 Monthly Reports

The WDQMS webtool provides monthly aggregations of the monitoring results (currently only for GBON) which can be downloaded.

RWCs should ~~provide monthly quality performance reports to NFPs of the corresponding RA or subregion by email and should also make them available online~~ make use of the WDQMS webtool. ~~Future to generate WDQMS monthly performance reports will supersede the current lead centre reports. Monthly reports should be generated and distributed automatically. Semester reports could include more detailed results than monthly reports.~~

~~Quality performance reports should describe the station and~~ which contains network monthly performances compared to WDQMS performance targets. ~~(see Annex 1) and The WDQMS reports should will contain, if possible:~~

~~1. Total number of raised incident tickets within the evaluated period (for example, per month) and per country.~~

~~2.1.~~ Total number of observations per station received in the month compared to the total number required, according to the observing schedule outlined in OSCAR/Surface. ~~Furthermore, the overall network performance for data availability should be provided on a monthly basis.~~

~~3.2.~~ Monthly average timeliness (delay between nominal observation time and reception time at a WIGOS Monitoring Centre's database) per station as well as the number of reports that have been received with a significant delay according to the targets. Furthermore, the overall network performance for timeliness will be provided on a monthly basis. ~~The monthly average timeliness is not quantified in WDQMS webtool currently.~~

~~4.3.~~ ~~Monthly arithmetic averages of daily pressure, temperature, wind and relative humidity, root mean squares of differences from Q-B NWP comparison results and monthly percentages of gross errors compared to the total number of all single observations for each variable and station. Furthermore, the overall network performance for data quality should be provided on a monthly basis.~~

~~5.~~ ~~Sorted station performances by listing station, with suspect records first, followed by stations with non suspect records, grouped by country and network.~~

~~3.~~ Monthly station metadata reports showing stations with OSCAR schedule issues, or other WIGOS metadata challenges outlined in OSCAR/Surface and stations not registered in OSCAR/Surface.

6.2. Quarterly reports

In addition to the monthly reports, the RWCs should prepare quarterly reports, to the WDQMS NFPs of their affiliated Members and should also make them available online on the RWC website, containing the following information, as much as possible:

1. List of raised incident tickets within the evaluated period per Member

2. List of outstanding incident tickets from previous evaluated period

3. List of activities in relation to correcting/improving the WIGOS metadata of Members

4. Quarterly availability results for the evaluated period per monitoring network per Member

5. Quarterly quality results for the evaluated period per monitoring network per Member

6. Quarterly station metadata results per Member

7. Optional functions conducted by RWC (if any)

The RWCs should provide regular (at least quarterly) quality performance reports to the WDQMS NFPs of their affiliated Members and should also make them available online on the RWC website.

Furthermore, the overall network performance for data availability as well as for data quality should be provided with sorted station performances by listing station, with suspect records first, followed by stations with non-suspect records, grouped by Member and network.

The IMS webtool is able to generate the required lists of incident tickets for the RWCs to include in the quarterly reports.

The content of the quality performance reports might evolve after feedback from Members using the reports.

ANNEX 1. PERFORMANCE TARGETS

1. ~~Surface synoptic land stations~~

~~The Observing Systems Capability Analysis and Review (OSCAR)/Surface tool and the *Manual on the Global Observing System, Volume II – Regional Aspects* (WMO, 2011b) define requirements for observation cycles. According to the Manual, a minimum of three observations at main hours in Universal Time Coordinated (UTC) and five observations at main and intermediate hours (3 h) are required (MRQ). The target is four observations at main hours in UTC and eight observations at main and intermediate hours (3 h) required (TRQ).~~

~~Table 1 provides values used as performance targets. They are examples for the WMO Integrated Global Observing System (WIGOS) Data Quality Monitoring System (WDQMS) of Regional Association (RA) VI. It is up to individual RAs to define their own performance targets.~~

Table 1. Performance targets for surface synoptic land stations

<i>Parameter</i>	<i>Target</i>			<i>Comment</i>
Data availability: percentage of observations received from the network	95% <i>Manual on the Global Observing System (WMO, 2011b)</i> MRQ: 50% TRQ: 95-100% (depending on the RA)			Percentage of monthly data available from the surface land station network according to the schedule outlined in OSCAR/Surface (number of observations received per month compared to number of observations expected per month)
Timeliness: percentage received by HH+100 HH+50	95% 90%			Percentage of data received by target times (HH+100 or HH+50) calculated on a monthly basis Targets relate to percentage of data received, not expected Threshold requirement Breakthrough requirement
<i>Parameter</i>	<i>Trueness—target for bias</i>	<i>Precision—target for standard deviation</i>	<i>Threshold for gross errors</i>	<i>Comment</i>
Pressure (hPa)	0.5 hPa	1.5 hPa	10 hPa ≤15% of all single observations	Bias as a measure of trueness: on average (several days), the absolute value of the daily calculated bias of pressure observations (P-BIAS) should not exceed the given target Standard deviation as a measure of precision: on average (several days), the daily calculated standard deviation of pressure (P-STDDEV) should not exceed the given target Gross errors: the number of gross errors during 1 month should not exceed a percentage of all single observations of that particular station Threshold requirement
<i>Parameter</i>	<i>Trueness—target for bias/mean vector difference (MVD)</i>	<i>Precision—target for standard deviation/root mean square vector difference (RMSVD)</i>	<i>Threshold for gross errors</i>	<i>Comment</i>

~~Geopotential height (m)~~	~~30 m~~	~~40 m~~	~~100 m <15% of all single observations~~	~~For surface land stations in mountainous areas only where no pressure observations are provided but geopotential heights (gpm) are Bias as a measure of trueness: on average (5 d), the absolute value of the daily calculated bias of gpm observations (gpm BIAS) should not exceed the given target Standard deviation as a measure of precision: on average (several days), the daily calculated standard deviation of gpm (gpm STDDEV) should not exceed the given target Gross errors: the number of gross errors during 1 month should not exceed a percentage of all single observations of that particular station Threshold requirement~~
~~Temperature (K)~~	~~0.5 K~~	~~Not currently specified: numerical weather prediction (NWP) 2 m temperature forecasts are not yet reliable to serve as reference~~	~~10 K <15% of all single observations~~	~~Bias as a measure of trueness: on average (5 d), the absolute value of the daily calculated bias of temperature observations (T BIAS) should not exceed the given target Standard deviation as a measure of precision: on average (several days), the daily calculated standard deviation of temperature (T STDDEV) should not exceed the given target Gross errors: the number of gross errors during 1 month should not exceed a percentage of all single observations of that particular station Threshold requirement~~
~~Wind vector (m s^{-1})~~	~~3.0 m s^{-1}~~	~~5.0 m s^{-1}~~	~~15 m s^{-1} <15% of all single observations~~	~~MVD as a measure of trueness: on average (several days), the absolute value of the daily calculated MVD of wind observations (WIND MVD) should not exceed the given target RMSVD as a measure of precision: on average (several days), the daily~~

				~~calculated RMSVD of wind should not exceed the given target~~ ~~Gross errors: the number of gross errors during 1 month should not exceed a percentage of all single observations of that particular station~~ ~~Threshold requirement~~
~~Relative humidity (%)~~	~~±10%~~		~~30%~~ ~~<15% of all single observations~~	~~Bias as a measure of trueness: on average (several days), the absolute value of the daily calculated bias of relative humidity observations (RH BIAS) should not exceed the given target~~ ~~Standard deviation as a measure of precision: on average (several days), the daily calculated standard deviation of relative humidity (RH STDDEV) should not exceed the given target~~ ~~Gross errors: the number of gross errors during 1 month should not exceed a percentage of all single observations of that particular station~~ ~~Threshold requirement~~

~~Table 2 shows the links to the sets of requirements from global NWP, for surface variables, available at the OSCAR/Requirements database.~~

Table 2. Links to requirements for global NWP, for surface variables, in OSCAR/Requirements

<i>Air pressure (at surface)</i>	<i>Air temperature (at surface)</i>	<i>Wind vector over the surface (horizontal)</i>	<i>Specific humidity</i>
ID 250	ID 253	ID 320	ID LT 303
http://www.wmo-sat.info/oscar/variables/view/10	http://www.wmo-sat.info/oscar/variables/view/12	http://www.wmo-sat.info/oscar/variables/view/183	http://www.wmo-sat.info/oscar/variables/view/161

2. Land upper air (radiosonde) stations

The OSCAR/Surface tool and the *Manual on the Global Observing System, Volume II – Regional Aspects* (WMO, 2011b) define requirements for observation cycles. According to the Manual, a minimum of one sounding at 12 UTC up to 100 hPa is required (MRQ). The target is two soundings at 00 and 12 UTC up to 10 hPa required (TRQ).

The provision of time and coordinates in Binary Universal Form for the Representation of meteorological data (BUFR) data as well as the provision of high-resolution BUFR data of all radiosonde stations is recommended (2 s).

Table 3 provides values used as performance targets. They are examples for RA-VI-WDQMS. It is up to individual RAs to define their own performance targets.

Table 3. Performance targets for upper air (radiosonde) land stations

<i>Parameter</i>	<i>Target</i>			<i>Comment</i>
Data availability: percentage of observations received from the network	95% <i>Manual on the Global Observing System (WMO, 2011b)</i> MRQ: 25–50% (depending on RA) TRQ: 95–100% (depending on RA)			Percentage of monthly data availability of the upper air (radiosonde) land network according to the schedule as outlined in OSCAR/Surface (number of soundings received per month compared to number of soundings expected per month)
Timeliness: percentage data received by HH+100 – the entire sounding (BUFR) or TEMP parts CD (Traditional Alphanumeric Code (TAC)) HH+50 – up to 100 hPa (BUFR) or TEMP parts AB (TAC)	95% 90%			Percentage of data received by target times (HH+100 or HH+50) to be calculated on a monthly basis Targets relate to percentage of data received, not expected Threshold requirements
Geopotential height: percentage achieving 100 hPa 50 hPa	97% 95%			Targets relate to percentage of data received, not expected Threshold requirements
<i>Parameter</i>	<i>Trueness – target for bias</i>	<i>Precision – target for standard deviation</i>	<i>Threshold for gross errors</i>	<i>Comment</i>
Temperature (K)	0.5 K	1.5 K	10 K <15% of all single observations	Bias as a measure of trueness: on average (several days), the absolute value of the daily calculated bias of temperature observations (T-BIAS) over all levels should not exceed the given target Standard deviation as a measure of precision: on average (several days), the daily calculated standard deviation of temperature (T-STDDEV) over all levels should not exceed the given target Gross errors: the number of gross errors during 1 month should not exceed a percentage of all single observations of that particular station Threshold requirement

<i>Parameter</i>	<i>Trueness— target for bias/MVD</i>	<i>Precision—target for standard deviation/RMSVD</i>	<i>Threshold for gross errors</i>	<i>Comment</i>
<u>Wind vector (m s^{-1})</u>	<u>3.0 m s^{-1}</u>	<u>5.0 m s^{-1}</u>	<u>15 m s^{-1} <15% of all single observations</u>	<u>MVD as a measure of trueness: on average (several days), the absolute value of the daily calculated MVD of wind observations (WIND MVD) over all levels should not exceed the given target RMSVD as a measure of precision: on average (several days), the daily calculated RMSVD of wind over all levels should not exceed the given target Gross errors: the number of gross errors during 1 month should not exceed a percentage of all single observations of that particular station Threshold requirement</u>
<u>Relative humidity (%)</u>	<u>10%</u>		<u>30% <15% of all single observations</u>	<u>Bias as a measure of trueness: on average (several days), the absolute value of the daily calculated bias of relative humidity observations (RH BIAS) over all levels should not exceed the given target Standard deviation as a measure of precision: on average (several days), the daily calculated standard deviation of relative humidity (RH STDDEV) over all levels (from the surface to the tropopause) should not exceed the given target Gross errors: the number of gross errors during 1 month should not exceed a percentage of all single observations of that particular station Threshold requirement</u>
<u>Observation minus background 100 hPa geopotential height difference (m)</u>	<u>65 m</u>			<u>Equates to 1 hPa error at 100 hPa</u>

Table 4 shows the links to the sets of requirements for global NWP, for upper air variables, available at the OSCAR/Requirements database.

Table 4. Links to requirements for global NWP, for upper air variables, in OSCAR/Requirements

<i>Atmospheric temperature</i>	<i>Wind (horizontal)</i>	<i>Specific humidity</i>
ID LT: 257 ID HT: 255	ID LT: 313 ID HT: 311	ID LT: 303 ID HT: 302
http://www.wmo-sat.info/oscar/variables/view/13	https://www.wmo-sat.info/oscar/variables/view/179	http://www.wmo-sat.info/oscar/variables/view/161

ANNEX 2.1. PRIORITY LEVELS OF ISSUES**1. Surface land stations**

The issues described in Table 1 shall be identified in most daily monitoring reports of the different WMO Integrated Global Observing System (WIGOS) Monitoring Centres, not in the daily monitoring reports of one particular WIGOS Monitoring Centre only.

Note: The timeline for issuing an incident ticket for NRT NWP monitoring is over five days and two days for GBON monitoring.

Table 1. Issues with surface land stations

<i>Category</i>	<i>Description</i>	<i>Level of priority</i>
Data availability (issues/incidents might be identified in Traditional Alphanumeric Code (TAC) and/or Binary Universal Form for the Representation of meteorological data (BUFR) data)	One station showed data outages occasionally	Low
	Several/all stations of one ~~Member~~ showed data outages occasionally ~~since 5-d ago~~	Medium
	~~One station reported <80% data availability~~	~~Medium~~
	~~Several/all stations of one NMHS/country Member reported <80% data availability~~	~~High~~
	One station did not provide any data ~~since 5-d ago~~	High
	Several/all stations of one ~~NMHS/country~~ ~~Member~~ did not provide any data ~~since 5-d ago~~	Very high
Timeliness (SYNOP data should be available for users within 50 min after the nominal observation time)	Data of one station seemed to arrive delayed (later than 100 min) occasionally ~~since 5-d ago~~	Low
	Data of several/all stations of one ~~NMHS/country~~ ~~Member~~ seemed to arrive delayed (later than 100 min) occasionally ~~since 5-d ago~~	Medium
	All data of one station seemed to arrive delayed (later than 100 min) ~~since 5-d ago~~	High
	All data of several/all stations of one ~~NMHS/country~~ ~~Member~~ seemed to arrive delayed (later than 100 min) ~~since 5-d ago~~	Very high
~~Accuracy/measurement uncertainty~~ ~~Quality~~ (issues/incidents might be identified for several parameters, for example pressure, temperature, wind and humidity)	Daily averages of quantitative measures of performance characteristics (based on observation minus background (O-B) results from numerical weather prediction (NWP)) of one station exceeded the target occasionally ~~since 5-d ago~~ (regarding bias [trueness], standard deviation [precision] or number of gross errors)	Low
	Daily averages of quantitative measures of performance characteristics (based on NWP O-B results) of several/all stations of one ~~NMHS/country~~ ~~Member~~ exceeded the target occasionally ~~since 5-d ago~~ (regarding bias [trueness], standard deviation [precision] or number of gross errors)	Medium
	All daily averages of quantitative measures of performance characteristics (based on NWP O-B results) of one station exceeded the target ~~since 5-d ago~~ (regarding bias [trueness], standard deviation [precision] or number of gross errors)	High
	All daily averages of quantitative measures of performance characteristics (based on NWP O-B results) of several/all stations of one ~~NMHS/country~~ ~~Member~~ exceeded the target ~~since 5-d ago~~	Very high

	(regarding bias [trueness], standard deviation [precision] or number of gross errors)	
Quality (issues/incidents might be identified concerning suspicious values in reports, for example negative temperatures or snow during the summer)	One station showed suspicious values in reports occasionally ~~in the last 5-d~~	Low
	Several/all stations of one ~~NMHS/country~~ Member showed suspicious values in reports occasionally ~~in the last 5-d~~	Medium
	All data of one station showed suspicious values in reports over several days ~~(in the last 5-d)~~	High
	All data of several/all stations of one ~~NMHS/country~~ Member showed suspicious values in reports over several days ~~(in the last 5-d)~~	Very high
Station Metadata	<u>One station reported >100% data availability</u>	Low
	<u>Several/all stations of one Member reported >100% data availability</u>	Medium
	<u>One station reported data but is not expected to send reports during the period according to OSCAR/Surface schedule</u>	Medium
	<u>Several/All stations of one Member stations reported data but are not expected to send reports during the period according to OSCAR/Surface schedule</u>	High
	<u>One station reported data but there is no corresponding station ID (not registered) in OSCAR/Surface</u>	High
	<u>Several/All stations of one Member reported data but there are no corresponding station IDs (not registered) in OSCAR/Surface</u>	Very High

2. Upper-air (radiosonde) land stations

The issues described in Table 2 shall be identified in most daily monitoring reports of the different WIGOS Monitoring Centres, not in daily monitoring reports of one particular WIGOS Monitoring Centre only.

Note: The timeline for issuing an incident ticket for NRT NWP monitoring is over five days and two days for GBON monitoring.

Table 2. Issues with upper-air (radiosonde) land stations

Category	Description	Level of priority
Data availability (issues/incidents might be identified in TAC and/or BUFR data)	One station showed data outages occasionally	Low
	Several/all stations of one ~~NMHS/country~~ Member showed data outages occasionally ~~in the last 5-d~~	Medium
	<u>One station reported a sounding with a completeness issue</u>	Low
	<u>Several/all stations of one Member reported a sounding with a completeness issue</u>	Medium
	<u>The total number of reports of one station is significantly lower than the expected number of soundings as defined in OSCAR/Surface</u>	High
	<u>The total number of reports of several/all stations of one Member are significantly lower than the expected number of soundings as defined in OSCAR/Surface</u>	Very high
	One station did not provide any data ~~since 5-d ago~~	High
	Several/all stations of one ~~NMHS/country~~ Member did not provide any data ~~since 5-d ago~~	Very high
Timeliness (data of an entire sounding should be available to users within 100 min after the nominal observation time)	Data of the entire sounding of one station seemed to arrive delayed (later than 100 min) occasionally ~~in the last 5-d~~	Low
	Data of the entire soundings of several/all stations of one ~~NMHS/country~~ Member seemed to arrive delayed (later than 100 min) occasionally ~~in the last 5-d~~	Medium
	All data of the entire sounding of one station seemed to arrive delayed (later than 100 min) ~~in the last 5-d~~	High
	All data of the entire soundings of several/all stations of one ~~NMHS/country~~ Member seemed to arrive delayed (later than 100 min) ~~in the last 5-d~~	Very high

<u>Accuracy/measurement uncertainty</u> <u>Quality</u> (issues/incidents might be identified for several parameters, for example pressure, temperature, wind and humidity)	Daily averages of quantitative measures of performance characteristics (based on O-B results from NWP) of one station exceeded the target occasionally ~~since 5-d ago~~ (regarding bias [trueness], standard deviation [precision] or number of gross errors)	Low
	Daily averages of quantitative measures of performance characteristics (based on NWP O-B results) of several/all stations of one ~~NMHS/country~~ Member exceeded the target occasionally ~~since 5-d ago~~ (regarding bias [trueness], standard deviation [precision] or number of gross errors)	Medium
	All daily averages of quantitative measures of performance characteristics (based on NWP O-B results) of one station exceeded the target ~~since 5-d ago~~ (regarding bias [trueness], standard deviation [precision] or number of gross errors)	High
	All daily averages of quantitative measures of performance characteristics (based on NWP O-B results) of several/all stations of one ~~NMHS/country~~ Member exceeded the target ~~since 5-d ago~~ (regarding bias [trueness], standard deviation [precision] or number of gross errors)	Very high
Quality (issues/incidents might be identified concerning suspicious values in the reports, for example negative temperatures or snow during the summer)	One station showed suspicious values in the soundings occasionally ~~in the last 5-d~~	Low
	Several/all stations of one ~~NMHS/country~~ Member showed suspicious values in soundings occasionally ~~in the last 5-d~~	Medium
	All data of one station showed suspicious values in soundings ~~since 5-d ago~~	High
	All data of several/all stations of one ~~NMHS/country~~ Member showed suspicious values in soundings ~~since 5-d ago~~	Very high
<u>Station Metadata</u>	<u>The total number of reports of one station is higher than the expected number of soundings as defined in OSCAR/Surface</u>	Low
	<u>The total number of reports of several/all station of one Member are higher than the expected number of soundings as defined in OSCAR/Surface</u>	Medium
	<u>One station reported data but is not expected to send reports during the period according to OSCAR/Surface schedule</u>	Medium
	<u>Several/All stations of one Member reported data but is not expected to send reports during the period according to OSCAR/Surface schedule</u>	High
	<u>One station reported data but there is no corresponding station ID (station not registered) in OSCAR/Surface</u>	High
	<u>Several/All stations of one Member reported data but there is no corresponding station ID (station not registered) in OSCAR/Surface</u>	Very High

ANNEX 32. FREQUENT ISSUES, POTENTIAL CAUSES OF INCIDENTS AND CORRESPONDING ACTIONS TO BE TAKEN

The figure below shows frequent issues arising in the WMO Integrated Global Observing System Data Quality Monitoring System (WDQMS), their potential sources and corresponding actions to be taken by data providers (usually National Meteorological and Hydrological Services/operators).

WDQMS frequent issues, potential sources and corresponding actions to be taken
 (BUFR = Binary Universal Form for the Representation of meteorological data; GOS = Global Observing System; **WIS/GTS = WMO Information System/**Global Telecommunication System; NWP = numerical weather prediction; O-B = observation minus background; OSCAR = Observing Systems Capability Analysis and Review Tool; TAC = Traditional Alphanumeric Code)

ANNEX 4.3. ACCURACY, TRUENESS AND PRECISION

1. Introduction

It is important to base underlying guidance material on accepted scientific knowledge and related general principles and definitions to establish community-wide accepted standards and best practices for observation monitoring. It is of particular importance here to use well-established mathematical, especially statistical, concepts and related terminology. The terms “accuracy”, “measurement uncertainty”, “trueness”, “precision” and a few more are often used when describing the quality of observations or measurements. Thus, it is important to precisely define the meaning and usage of these terms. A commonly shared understanding of the underlying terminology allows effective and efficient WMO-wide collaboration on quality monitoring, evaluation and incident management. General principles and definitions are described in this annex, and some terminology is brought into the specific context of monitoring routine meteorological observations with the help of numerical weather prediction (NWP) forecasts.

2. Definitions and interrelationships among types of errors

International Organization for Standardization (ISO) standard ISO 5725-1:1994 describes the meaning, usage and interrelation of terms such as accuracy and trueness.

According to ISO 5725-1:1994, “accuracy” means “the closeness of agreement between a test result and the accepted reference value”. In the context of meteorological observations, a “test result” means a measurement or observation. Furthermore, according to ISO 5725-1:1994, “accuracy” refers to “trueness” and “precision”. Thereby the following hold: “trueness” refers to the closeness of agreement between the arithmetic mean of a large number of test results and the true or accepted reference value and “precision” refers to the closeness of agreement between test results.

While the terms “accuracy”, “trueness” and “precision” describe performance characteristics of a measurement or a set of measurements, the terms “total error”, “systematic error” and “random error” describe the underlying related types of error in mathematical/statistical language. Finally, the terms “measurement uncertainty”, “bias” and “standard deviation” are the related quantitative expressions of performance characteristics.

Measurements and observations are usually not free of errors. Measurements can be considered an estimate of the true state of a parameter. However, truth is usually unknown. And when measuring or observing, measurement or observational errors occur. The difference between the measured or observed value and the true but unknown value is often called the total error. This total error consists of two parts: the systematic error and the random error. The systematic error is an offset, and remains constant in magnitude and sign when repeating measurements. The random error varies when measurements are repeated, that is, the magnitude and sign of the random error fluctuates. Systematic error and random error usually cannot be determined precisely because truth and total error are usually unknown. Therefore, the errors have to be estimated in practice. The error estimates are generally referred to as performance characteristics. Trueness is an estimate of systematic error and precision estimates the random error.

Quantitative expressions of the performance characteristics are defined as follows.

“Bias” is the quantitative measure of trueness. To calculate the bias, for a repeated measurements of the same parameter, the difference between measured value and a reference value is initially determined. In a second step, the bias is calculated as the average of these differences. The reference value can be another independent very precise measurement or another estimate of truth. In operational meteorology, short-term numerical weather forecasts can serve as independent estimates of the true atmospheric state.

“Standard deviation” is the quantitative expression of precision. Both bias and standard deviation contribute to the overall measurement uncertainty, which is a quantitative expression of accuracy.

Note: The aforementioned description of interrelationships among types of errors, performance characteristics and quantitative expressions of performance characteristics is based on a related text available at <https://sisu.ut.ee/measurement/7-precision-trueness-accuracy>, which is an online course on Estimation of Measurement Uncertainty in Chemical Analysis, by Mr Ivo Leito from University of Tartu, Estonia.

3. Numerical weather prediction short-term forecasts as reference in the procedure for measuring accuracy, trueness and precision

To assess the quality (accuracy) of observations, a comparison of the observation “to be assessed” and a “reference” has to be made. Ideally, the truth would be used as reference. However, truth is unknown and it is therefore necessary to search for very good estimates of the truth. This can be other observations or modelling results. At special observatories (that is, only in a few places), it is affordable to compare observations against other independent observations from different observing systems. This can be achieved by using two sensors that are the same or by using slightly different sensors for the same physical parameter.

However, for large and widespread operational observing networks, a cheaper reference is needed. Currently, the only omnipresent references are NWP model forecasts of the physical parameters of interest. Therefore, instead of comparing observations against other observations, using other references should be considered (for example, comparing observations against forecasted fields of the observed variables). This was demonstrated in an article by Hollingsworth et al. (1985). That article describes how the predictive skill of NWP models improved from 1975 to 1985, and it concludes that “it is therefore reasonable to suppose that in areas with even moderate data coverage the accuracy of the analysis should be comparable with the accuracy of the observations”. More specifically, it states that “the 6-hour prediction error is comparable with the observation error”. Based on this finding, it is reasonable to use short-term numerical forecasts as reference for observation quality (accuracy) monitoring. Such short-term forecasts are used as background information in assimilation procedures and then often referred to as “first guesses”. The article by Hollingsworth et al. (1985) explains that the “observation minus first guess” or “observation minus background” differences have a simple statistical structure. It argues that “large variations of the statistics from station to station, or large biases, are indicative of problems in the data or in the assimilation system”. The effect of weather/synoptic variations that would generally prevent a direct comparison of the data quality of different observing sites can now be removed by subtracting the “forecasted weather”.

Other global modelling centres have also implemented similar observation data and assimilation system monitoring tools. An article by Baker (1992) describes quality control for the Navy Operational Atmospheric Database; that by DiMiego (1988) outlines the National Meteorological Center Regional Analysis System in the United States of America; and that by Ingleby (1992) explains The New Meteorological Office Quality Control System of the Met Office in the United Kingdom of Great Britain and Northern Ireland.

The following should be taken into account for day to day monitoring of observation accuracy by means of comparison against NWP forecasts:

- Modelled temperature and wind fields in the free atmosphere taken from very short-range forecasts are accurate enough and can be used as reference for observations. Routine ongoing (such as daily) monitoring of, for example, radiosonde temperature and wind data against the corresponding model data taken from short-term forecasts (called “first guess” in data assimilation terminology) can at least help to spot drifts or jumps in the quality of observations.
- Representativeness of model forecasts for other parameters (such as humidity and precipitation) or for certain parameters near the surface (at the border between the atmosphere and ground/sea/ice) is limited. For such parameters, monitoring against NWP

model results has to be conducted with care. Nevertheless, it is possible to identify sensor drifts or sudden jumps in "observation minus first guess/background fields" (identification of systematic errors).

- Quality figures from models have to be considered with care, especially for observations from mountainous and partly maritime regions. The representativeness of model forecasts is much smaller in such places.

The advantage of the above approach of using NWP outputs as a reference for quality (accuracy) monitoring of observations is that it allows relatively cheap detection of long-lasting drifts or sudden and significant jumps in sensor readings (poor data quality).

~~ANNEX 5. FILE FORMAT FOR EXCHANGING INFORMATION ON LAND SURFACE OBSERVATIONS~~

~~The data file for exchanging information on land surface observations from Global Numerical Weather Prediction (NWP) Centres (as of 8 December 2017) contains information about the status of the global land surface observational system in ASCII format. The first six lines (header) are identified by "#" and contain general information about the data that follow (see example below). The data are organized by line, where each line (data record) corresponds to an observation of a particular variable; the values on each line are separated by commas (.csv):~~

~~Each record has the following format:~~

~~---- Station_id,yyyymmdd,HHMMSS,latitude,Longitude,StatusFlag,Centre_id,var_id,Bg_dep~~

~~where~~

~~---- Station_id (string) is the WMO station identifier;
 ---- yyyymmdd (integer) is the observation date (yyyy is year, mm is month, dd is day);
 ---- HHMMSS (integer) is the observation time (HH is hour, MM is minutes, SS is seconds);
 ---- Latitude (float) is the geographical latitude of the station in decimal format;
 ---- Longitude (float) is the geographical longitude of the station in decimal format;
 ---- StatusFlag (integer) is the computed flag with information about the usage of the observation parameter within the NWP data assimilation system (see table below);
 ---- Centre_id (string) is the name of the originating centre;
 ---- var_id (integer) is the identifier of the observation parameter;
 ---- Bg_dep (float) is the observation minus background residuals (also known as background departures):~~

~~The table below provides a summary of the quality flags used. A comprehensive description of the flagging system is given on the Wiki page under the WMO Integrated Global Observing System Data Quality Monitoring Flagging System for registered users (<https://software.ecmwf.int/wiki/display/WIGOS>):~~

Quality flags

<i>StatusFlag</i>	<i>Meaning</i>
0	Used
1	Not used
2	Rejected by data assimilation process
3	Never used by data assimilation process
4	Data thinned
5	Rejected before data assimilation process
6	Alternative used
7	Quality issue
8	Other reason
9	No content

Note that the observed variables included in the files are the following: surface pressure (var_id = 110), 2 m temperature (var_id = 39), 2 m relative humidity (var_id = 58), and zonal and meridional components of surface wind at 10 m (var_id = 41 and var_id = 42, respectively). The units of observation minus background residuals (Bg_dep) are K, hPa, m s⁻¹ and hundredths of percentage for temperature, pressure, wind and relative humidity, respectively.

Example

```

----- # TYPE=SYNOP
----- #An_date= 20161204
----- #An_time= 18
----- #An_range=] 15 to 21 ]
----- #StatusFlag: 0(Used);1(Not Used);2(Rejected by DA);3(Never Used by DA);4(Data
----- Thinned);5(Rejected before DA);6(Alternative Used);7(Quality Issue);8(Other
----- Reason);9(No content)
----- #Station_id,yyyymmdd,HHMMSS,latitude,Longitude,StatusFlag,Centre_id,var_id,Bg_dep
----- 16469,20161204,210000,37.93000,16.06000,5,ECMF,110,-1.4
----- 31913,20161204,210000,45.22000,131.98000,2,ECMF,110,-0.1

```

ANNEX 6. FILE FORMAT FOR EXCHANGING INFORMATION ON UPPER-AIR LAND OBSERVATIONS

The data file for exchanging information on upper-air land observations from Global Numerical Weather Prediction (NWP) Centres (as of 13 February 2018) contains information about the status of the global upper-air land observational system in ASCII format. The first six lines (header) are identified by “#” and contain general information about the data that follow (see example below). The data are organized by line, where each line (data record) corresponds to a (predefined) vertical layer summary per observed/assimilated variable; the values on each line are separated by commas (.csv).

Each record has the following format:

```

----- Station_id,yyyymmdd,HHMMSS,latitude,Longitude,StatusFlag,Centre_id,var_id,Mean_Bg_
----- dep,Std_Bg_dep,Levels,LastRepLevel,CodeType

```

where

```

----- Station_id (string) is the WMO station identifier;
----- yyyymmdd (integer) is the observation date (yyyy is year, mm is month, dd is day);
----- HHMMSS (integer) is the observation time (HH is hour, MM is minutes, SS is seconds);
----- Latitude (float) is the geographical latitude of the station in decimal format;
----- Longitude (float) is the geographical longitude of the station in decimal format;

```


----- StatusFlag (integer) is the computed flag with information about the usage of the observation parameter within the NWP data assimilation system (see the table above in Annex 5);

----- Centre_id (string) is the name of the originating centre;

----- var_id (integer) is the identifier of the observation parameter (see the table below in this annex);

----- Mean_Bg_dep (float) is the layer average observation minus background residuals (also known as background departures);

----- Std_Bg_dep (float) is the layer standard deviation observation minus background residuals (also known as background departures);

----- Levels (string) is a four-character string indenting the layer used to compute the statistics: "Surf" is for the surface, "Trop" is for the first level up 100 hPa inclusive and "Stra" is for the 100 hPa level up to the top level reported;

----- LastRepLevel (float) is the last reported pressure level in the radiosonde;

----- CodeType (integer) is the identifier of the observation type (for example, 35 and 109 refer to land upper air observations formatted using the Traditional Alphanumeric Code and the Table-driven Code Form/Binary Universal Form for the Representation of meteorological data, respectively);

Example

```
----- # TYPE=TEMP
----- #An_date= 20171115
----- #An_time= 18
----- #An_range=] 15 to 21 ]
----- #StatusFlag: 0(Used);1(Not Used);2(Rejected by DA);3(Never Used by DA);4(Data Thinned);5(Rejected before DA);6(Alternative Used);7(Quality Issue);8(Other Reason);9(No content)
----- #Station_id,yyyymmdd,HHMMSS,latitude,Longitude,StatusFlag,Centre_id,var_id,Mean_Bg_dep,Std_Bg_dep,Levels,LastRepLevel,CodeType
----- 01001,20171115,173435,70.93970,-8.66791,0,ECMF,2,-0.1276,0.6259,Trop,100.0,109
----- 01001,20171115,173435,70.93970,-8.66791,0,ECMF,29,0.0171,0.0915,Trop,100.0,109
----- 01001,20171115,173435,70.93970,-8.66791,0,ECMF,3,0.5818,1.6464,Trop,100.0,109
----- 01001,20171115,173435,70.93970,-8.66791,0,ECMF,4,-0.2153,1.7774,Trop,100.0,109
----- 47122,20171115,180000,37.08000,127.03000,0,ECMF,2,0.3631,1.0317,Trop,166.0,35
----- 47122,20171115,180000,37.08000,127.03000,0,ECMF,29,0.0426,0.0757,Trop,166.0,35
----- 47122,20171115,180000,37.08000,127.03000,0,ECMF,3,1.4831,3.0970,Trop,166.0,35
----- 47122,20171115,180000,37.08000,127.03000,0,ECMF,4,-0.2008,1.7213,Trop,166.0,35
----- 47158,20171115,180000,35.12000,126.80000,0,ECMF,2,0.2755,0.9581,Trop,7.2,35
----- 47158,20171115,180000,35.12000,126.80000,0,ECMF,2,-0.0509,2.1681,Stra,7.2,35
----- 47158,20171115,180000,35.12000,126.80000,0,ECMF,29,0.0354,0.1027,Trop,7.2,35
----- 47158,20171115,180000,35.12000,126.80000,5,ECMF,29,0.0035,0.0074,Stra,7.2,35
----- 47158,20171115,180000,35.12000,126.80000,0,ECMF,3,0.8701,1.8287,Trop,7.2,35
----- 47158,20171115,180000,35.12000,126.80000,0,ECMF,3,0.4957,3.8780,Stra,7.2,35
----- 47158,20171115,180000,35.12000,126.80000,0,ECMF,4,-0.1994,1.7315,Trop,7.2,35
----- 47158,20171115,180000,35.12000,126.80000,0,ECMF,4,0.4891,3.3831,Stra,7.2,35
```

The table below gives a description of the var_id codes:

var_id codes

<i>var_id</i>	<i>Name</i>	<i>Abbreviation</i>	<i>Units</i>
2	Upper air temperature	t	K
3	Upper air zonal wind component	u	m.s ⁻¹
4	Upper air meridional wind component	v	m.s ⁻¹
29	Upper air relative humidity	rh	Hundredths of %
110	Surface pressure	ps	hPa

~~ANNEX 7. EXAMPLE INCIDENT MANAGEMENT SYSTEM TICKET~~

~~The figure below provides an example of an incident management system ticket.~~

~~**Example incident management system ticket (DA = data assimilation; ECMWF = European Centre for Medium-range Weather Forecasts; GTS = Global Telecommunication System; JMA = Japan Meteorological Agency; NCEP = National Centers for Environmental Prediction; NWP = numerical weather prediction; RTH = Regional Telecommunication Hub; UTC = Universal Time Coordinated)**~~

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Резолюция 6 (ИНФОМ-3)

Обновление Руководящих принципов по наилучшим практикам обеспечения готовности пользователей к использованию метеорологических спутников нового поколения (ВМО-№ 1187)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 37 \(Кг-17\)](#) «Подготовка к использованию новых спутниковых систем»,
- 2) [резолюцию 12 \(ИС-65\)](#) «Региональные потребности в доступе к спутниковым данным и обмене ими»,

- 3) [решение 4 \(КОС-16\)](#) «Передовые практики обеспечения готовности пользователей к использованию метеорологических спутников нового поколения»,
- 4) [резолюцию 47 \(Кг-19\)](#) «Обязательные публикации ВМО и политика в области распространения на девятнадцатый финансовый период»,

отмечая:

- 1) [Руководящие принципы по наилучшим практикам обеспечения готовности пользователей к использованию метеорологических спутников нового поколения](#) (ВМО-№ 1187), в которых представлены наилучшие практики для проектов по обеспечению готовности пользователей, реализуемых организациями пользователей, и для программ разработки спутников в целях поддержки обеспечения готовности пользователей,
- 2) Инструмент анализа и обзора возможностей космических систем наблюдений ВМО (ОСКАР/Космос), являющийся частью оперативных информационных ресурсов Интегрированной глобальной системы наблюдений ВМО (ИГСНВ) и содержащий комплексную информацию по космическим системам, актуальным для Членов ВМО,

отмечая также:

- 1) что переход к эксплуатации новых спутниковых систем позволяет существенно улучшить продукцию и обслуживание, предоставляемые Членами ВМО,
- 2) что осуществление подобных новых спутниковых систем в оперативных схемах оказывает решающее воздействие на инфраструктуру, системы, применения и обслуживание пользователей и в целом требует скоординированных действий на научном, техническом, финансовом, организационном и образовательном уровнях,
- 3) что своевременная подготовка является базовым условием для того, чтобы избежать сбоев в оперативной работе в процессе перехода,
- 4) что одним из главных препятствий для планирования проекта по обеспечению готовности пользователей является несвоевременная доступность сведений о потребностях, спецификаций, а также данных и инструментов, используемых при развертывании соответствующих спутниковых систем,
- 5) что спутниковые системы новых поколений, вносящие значительный вклад в реализацию [Перспективного видения в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году](#) (ВМО-№ 1243), уже используются или будут использоваться в течение нынешнего десятилетия многими странами как на геостационарных, так и на низких околоземных орбитах,

отмечая далее, что пересмотр *Руководящих принципов по наилучшим практикам обеспечения готовности пользователей к использованию метеорологических спутников нового поколения* (ВМО-№ 1187) (далее — «Руководящие принципы») отражает уроки, извлеченные из использования спутниковых систем, введенных в эксплуатацию за последние 5—10 лет, новые типы полетов на низкую околоземную орбиту, возрастающую роль коммерческих поставщиков спутниковых данных, а также изменения в потребностях пользователей,

приняв во внимание:

- 1) что пересмотр *Руководящих принципов* рассмотрен Постоянным комитетом по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ) и его Экспертной группой по космическим системам и их использованию (ЭГ-КСИ),

- 2) что пересмотр *Руководящих принципов* был принят на пятьдесят первом пленарном заседании Координационной группы по метеорологическим спутникам (КГМС),

принимает пересмотр *Руководящих принципов* вместе с пересмотренным названием «*Руководящие принципы по наилучшим практикам обеспечения готовности пользователей к использованию спутниковых систем нового поколения*» (ВМО-№ 1187), как указано в дополнении к настоящей резолюции;

порукает ПК-СНСМ:

- 1) принять в сотрудничестве со спутниковыми операторами необходимые меры с целью расширения информированности среди Членов ВМО для содействия плавному переходу к эксплуатации новых спутниковых систем;
- 2) принять соответствующие меры в сотрудничестве со спутниковыми операторами с целью поощрения коммерческих поставщиков спутниковых данных к тому, чтобы они следовали практикам, изложенным в *Руководящих принципах*, для обеспечения готовности пользователей к использованию всех основных данных, особенно для применений в области глобальных численных прогнозов погоды (ЧПП);
- 3) изучить возможность создания центров спутникового применения, которые могли бы помочь Членам повысить эффективность использования спутниковых данных и продукции, разработать концепцию и обновить *Руководящие принципы* в следующий межсессионный период в сотрудничестве с КГМС, при необходимости;

настоятельно призывает всех заинтересованных Членов ВМО в преддверии запуска спутниковых систем нового поколения разработать проекты по подготовке пользователей в соответствии с *Руководящими принципами*;

настоятельно призывает спутниковых операторов предоставлять регулярные и своевременные обновления спутниковых систем нового поколения посредством соответствующих средств и особенно через посредство вклада в инструмент ОСКАР/Космос для оказания поддержки в реализации проектов по обеспечению готовности пользователей.

Дополнение к резолюции 6 (ИНФОМ-3)

Guidelines on Best Practices for Achieving User Readiness for New Satellite Systems

REFERENCE USER-READINESS PROJECT

1. Background

The space-based component is an essential part of the WMO Integrated Global Observing System (WIGOS), as outlined in the [Vision for the WMO Integrated Global Observing System in 2040](#) (WMO-No. 1243). New generations of satellite systems will bring significant improvements to satellite-based products and services delivered by WMO Members provided that users can effectively reap their benefits. These new systems will provide users with new types of data, with overall data volumes that are one or more orders of magnitude higher than those of the previous generation. Integrating these new data types into their operational schemes will have major impacts on users' infrastructures, systems, applications and services and will require coordinated actions at the scientific, technical, financial, organizational and educational levels. To avoid any disruption to their operations during the transition to these new satellite systems and to ensure that they take advantage of the new capabilities of the

new systems in a timely manner, it is essential that satellite data users be prepared to utilize the new types of data as effectively and as early as possible.

New generations of satellite systems contributing significantly to fulfilling the WIGOS vision have been or will be employed by China, India, Japan, the Republic of Korea, the Russian Federation, the United States of America and the European Union, in both geostationary Earth orbit (GEO) and low Earth orbit (LEO). It is anticipated that other nations may also start planning their satellite missions in the future.

In LEO, core satellite systems in early morning, mid-morning and afternoon Sun-synchronous orbits are now providing microwave (MW) and hyperspectral infrared (IR) sounding and medium resolution IR/visible (VIS) imaging, ultraviolet (UV) spectrometry, radio occultation, and scatterometry. In addition, a number of LEO satellites in Sun-synchronous and drifting orbits are becoming operational, providing observational capabilities for atmospheric composition, ocean observations, land surface observations and other observational domains.

The WMO Commission for Basic Systems Guidelines for Ensuring User Readiness for New-Generation Satellites were adopted by the Commission for Basic Systems (CBS) at its fifteenth session (*Commission for Basic Systems – Fifteenth Session: Abridged Final Report with Resolutions and Recommendations* (WMO-No. 1101) – *Annex I* (Annex to Paragraph 4.2.36 of the General Summary)). They focus on user preparation for the new generation of meteorological satellites and urge the “Establishment by each concerned National Meteorological and Hydrological Service (NMHS) or other operational user organization, of a user-readiness project focused on the introduction of new satellite data streams into operations (to be initiated ~5 years prior to launch)”.

Against this background, in 2015, the World Meteorological Congress, at its seventeenth session, through *Resolution 37 (Cg-17)* – Preparation for new satellite systems (*Seventeenth World Meteorological Congress: Abridged Final Report with Resolutions* (WMO-No. 1157)), strongly recommended “to all concerned Members to set up user preparation projects in advance of the launches of new satellite systems, in accordance with the CBS Guidelines for ensuring user readiness for new-generation satellites”.

One of the main constraints for the planning of a user-readiness project is the timely availability of the requirements, specifications, data and tools used in the development of the corresponding satellite system. It is therefore crucial that satellite development entities and operators provide detailed and up-to-date plans for their activities in order to support user-readiness projects.

For this reason, *Resolution 37 (Cg-17)* also welcomed the implementation of the Satellite User Readiness Navigator (SATURN), which at one time served as a one-stop portal for technical information from satellite operators concerning new satellite systems. This effort was aimed at supplementing satellite operator portals by creating a link between users and satellite operators to address an important gap. Since 2015, satellite operators have worked towards improving the usability of their web pages to ensure that the process of preparing users for new satellite data starts early.

The WMO Space Programme has analysed how the typical cycle of satellite system development relates to user-readiness projects, and the outcome of this analysis is a summary of best practices and a generic project schedule (outlined in the [table](#)). The generic schedule indicates what information should be available to both satisfy the user preparation schedule and respect the constraints of satellite system development and when that information should be available relative to the planned satellite launch.

The WMO Commission for Basic Systems (CBS), at its sixteenth session, through *Decision 4 (CBS-16)* – Best Practices for Achieving User Readiness for New Meteorological Satellites (*Commission for Basic Systems – Sixteenth session: Abridged Final Report with Resolutions and Recommendations* (WMO-No. 1183)), endorsed the *Guidelines on Best*

Practices for Achieving User Readiness for New Meteorological Satellites (WMO-No. 1187) as CBS guidance published in 2017.

The revision of this publication reflects lessons learned from the satellite systems that have become operational over the last 5–10 years (such as Himawari-8/9, the Geostationary Operational Environmental Satellite (GOES)-R series (GOES-R), GEO-Kompsat-2, FengYun-4 (FY-4), FengYun-3 (FY-3) and the Joint Polar Satellite System (JPSS)), novel types of LEO missions, the increasing role of commercial satellite data providers, as well as evolutions in user needs.

2. Applicability

The current publication presents, in an integrated manner, best practices for user-readiness projects carried out by user organizations (for example, NMHSs) as well as for satellite development programmes to support user readiness. They contain a list of deliverables, with the corresponding timelines, which should be made available to user-readiness projects by satellite development programmes.

The best practices described herein therefore apply to both, user organizations (see [section 4](#)) and satellite operators (see [section 6](#)).

They apply to all satellite systems providing sustained observations in response to operational user needs but focus on satellite systems that provide data which are critical for operational Earth system predictions, severe weather event warnings and the protection of life and property. User organizations and satellite operators have a shared responsibility to ensure that satellite data can provide maximum value for critical application areas.

The present document focuses on the critical time frame from five years before to two years after satellite launch; this forms part of a continuous user engagement process that starts even before formal approval of the satellite programme and continues throughout its lifetime.

The present publication is primarily intended for members of the Coordination Group for Meteorological Satellites (CGMS) and WMO, but the broader user community can also benefit from the information herein when shaping user readiness projects in their institutions.

The document is a very important guidance for commercial satellite data providers, and both CGMS and WMO will strive to ensure that the practices herein are followed for user-readiness preparations for all essential data provision, especially for global numerical weather prediction (NWP) applications.

3. Dialogue between space agencies and users

As a foundation for all user-readiness activities for satellite programmes, it is important to establish a two-way dialogue between users and data providers early during satellite system development. This is to inform users of what they can expect from the new observations, as well as for users to plan their preparation activities and express what they require in order to efficiently and effectively use the new data. Areas that will benefit especially from such early dialogues include expected data characteristics, format definitions, dissemination routes, proxy data, embedded integration of subject matter experts, end-to-end testing, identifying research and development needs for data applications, training/education needs, as well as identifying “readiness blockers” that require addressing by the user or the provider.

Efficient practices to facilitate this dialogue include satellite user conferences, scientific advisory groups, proving ground initiatives, testbeds, and early adopter programmes which engage expert users and space programme developers. The National Oceanic and Atmospheric Administration (NOAA) proving ground initiatives for GOES-R and JPSS, and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) user preparation

projects for Meteosat Third Generation (MTG) and EUMETSAT Polar System-Second Generation (EPS-SG) have proven to be very efficient in supporting user readiness.

User groups established through these activities can also play an important role in the early in-orbit evaluation of satellite data, including the early demonstration of new capabilities of data applications.

User engagement workshops can help identify key needs of user communities as well as recommended user requirements for future observations. Engagement with the wider user community through, for instance, the appropriate CGMS science working groups, is essential in order to ensure that users are informed about the new types of data and that user preparation activities are targeted and efficient.

Two critical elements of the dialogue between users and data providers are the identification of development needs for data applications, and discussions on appropriate resourcing, taking into account the budget realities for both the satellite programmes and the users. User engagement that includes research and development and the academic sector can help identify major research and development areas related to the new data. This, in turn, will accelerate the development of new products and applications and will inform upgrades to the supporting infrastructure of both the satellite providers and the users. The return of investing in space programmes can be greatly enhanced if the necessary development needs are identified early and sufficiently resourced. Identifying commonalities between different satellite programmes (for example, for radiative transfer modelling and data processing) and the development of community tools through user networks such as the EUMETSAT Satellite Application Facilities can be very cost-effective in this respect.

The level of dialogue required depends on the degree of novelty of the instrument. More extensive dialogue is needed to establish user-readiness requirements for a system with completely new sensing capabilities.

4. Activities by users to achieve readiness

The activities described below should be performed by user organizations to achieve readiness for new-generation satellites.

4.1 *Establishment of a user-readiness project*

It is crucial that the planning of a user-readiness project start early. The present *Guidelines* assumes that users need to prepare for an entirely new generation of satellites, in which case, the user-readiness project needs to be defined five years prior to satellite launch. In particular, it is crucial, as early as possible, to:

- (a) Clearly define project outcomes and deliverables;
- (b) Establish clear responsibilities and accountabilities;
- (c) Ensure that an adequate budget is available for all activities;
- (d) Establish a clear go-live plan for the upgraded infrastructure and new services;
- (e) Develop communication networks between satellite operators, key managers, project stakeholders, and users.

The user-readiness project needs to address the following areas:

- (a) New capabilities, as well as improvements to existing capabilities;
- (b) Operational service provision continuity, including critical path analysis for transition;

- (c) Obtaining maximum benefits from existing assets and protecting investments;
- (d) Maximizing service value at all times during the transition;
- (e) Research and development opportunities that underpin or benefit the development of novel products and applications;
- (f) Ensuring that the transition of users to the new system takes place in a timely fashion.

The project must also include a detailed assessment of opportunities and risks. It may be opportune to embed the project activities within larger-scale activities aimed at upgrading the service and improving its resources.

During the execution of the project, special consideration must be given to:

- (a) The need for a dedicated project manager (overall accountability is important);
- (b) Maintaining contact with the satellite operator for up-to-date information;
- (c) Maintaining regular communication between key managers and project stakeholders (to maintain momentum and counter misinformation);
- (d) Monitoring key project milestones with a view to escalating activities when necessary;
- (e) Ensuring that management support and buy-in is available when needed;
- (f) Managing expectations regarding the availability of new products.

4.2 *Budgeting and planning*

Budgeting and planning are of paramount importance and need to start early. A new-generation satellite system can be, in some cases, the driver of significant infrastructure upgrades and increased performance requirements in terms of data acquisition, storage and networks; as such, users should be made aware of the system many years in advance of the satellite launch so that they can incorporate the necessary upgrades into their long-term evolution and investment plans. Schedule margins and other provisions should be realistic in order to avoid potential difficulties, due, for example, to launch delays.

A main objective for a user organization is to protect the investment made in existing operational programmes and to understand early where additional investments are necessary or unavoidable to achieve readiness for the new satellite system. It is therefore crucial for users to receive information about investment drivers as early as possible for budgeting and planning purposes.

4.3 *Research and development*

Research and development needs should be identified early in the preparation phase in dialogue with the data providers. In this context, “research and development” refers to the phase of activities that prepares users for the application of new-generation satellite data. This typically includes the development of NWP data assimilation methods using the new-generation satellite data where needed or the development of new or specially tailored products for specific application areas, for instance, by centres such as the EUMETSAT Satellite Application Facilities. These activities usually include computationally efficient tools to simulate the new observations, an analysis of the effects of instrument spectral response functions (SRFs), field of view (FOV), and so forth. Where possible, the use of common community software is advisable (for example, Radiative Transfer for the Television Infrared Observation Satellite (TIROS) Operational Vertical Sounder (TOV) (RTTOV) software, Community Radiative Transfer Model (CRTM) software) to ensure efficient and consistent developments.

Planning such activities depends to a large extent on the degree of novelty of the instrument. For an upgraded version of an existing instrument series, the lead times can be shortened considerably, and some steps (for example, simulated data) can be dropped completely. In contrast, in the case of totally new instruments, an in-depth analysis of the specific development requirements is needed, taking into account the accuracy of forward-modelling tools, expected data volumes, and other processing needs. For instance, if an instrument measures in a spectral region not previously covered by other instruments, research into the spectroscopy for that region may be needed. Alternatively, if an instrument will provide a step-change in the amount of data, efficient methods of representing the information may need to be developed. To enable such research, a first-guess spectral response function may be useful as early as four years before the launch date; for this spectral response function, simulated data would be very useful. For observations using a completely new measurement method, entirely new forward-modelling tools may need to be developed to enable quantitative exploitation of the data, which may require substantial development.

Research and development activities do not stop at the end of satellite commissioning of novel sensors, as it can take several years for their full capacity to be realized. Continuing to stimulate research and development interests and funding sources to encourage user engagement is important, as is identifying supporting agencies with the capacity to champion research to operations.

4.4 *Data-handling development and testing*

This activity includes the design and procurement of new satellite reception systems, as well as the upgrades to terrestrial network access (Internet, Regional Meteorological Data Communication Network (RMDCN), and National Research and Education Network (NREN) services) needed to handle the increased data rates. It also encompasses upgrades to observational databases, short- and long-term archives, internal networks, and general information technology capacity for visualization, monitoring and processing.

It is crucial that the procurement of data-handling systems start early to enable complete testing of all technical and scientific aspects of the processing chain.

4.5 *Data-processing development and testing*

The software used to process satellite observations may need to be adapted and potentially upgraded to accommodate data from a new satellite. The changes required may include:

- (a) Updating the local processing chain used to incorporate direct-broadcast (DB) data into level 0 (L0) and level 1 (L1) products;
- (b) Acquiring additional software to derive level 2 (L2) products;
- (c) Converting data into intermediate local formats and using data subsets for smaller regions of interest for observation databases and archiving;
- (d) Incorporating data monitoring and assimilation into NWP models;
- (e) Adapting the processing chain to locally generate higher-level products for specific applications using on-premises systems and/or the Cloud;
- (f) Integrating data into the operational user environment, including, for instance, into integrated visualization applications (with satellite, radar, surface and altitude observations and model outputs) for forecasters.

For example, adapting NWP assimilation to new satellite systems requires long lead times and has specific requirements regarding the availability of instrument and product data.

It is essential that synthetic test data, with realistic data volumes and appropriate operational formats, be used when conducting end-to-end tests of the data-processing systems. These

tests should be in the form of “stress-tests” in order to check that the systems are able to deal with the expected data volumes.

The changes required to ensure that the software can process the data from the new satellites will vary widely according to the needs and capabilities of each user organization and will require careful coordination with the users.

4.6 Contributions to calibration and validation

It has become a standard practice for NWP centres to participate in instrument calibration and validation activities for both LEO and GEO satellites. In addition, satellite operators monitor “first-guess-minus-observation” departures for L1 products as part of their calibration and validation activities, and feedback and impact analysis from NWP users have become integrated components in the calibration and validation process. These activities should also continue to ensure user readiness for new-generation satellites.

5. Capacity-development

Capacity-development is vital to ensure that all WMO Members are able to exploit the value of the new generation of satellite data to the maximum. Capacity- development activities can take the form of bilateral NMHS partnerships, regional collaborative mechanisms such as user forums or conferences, and WMO regional coordination groups on satellite data requirements. Training is one of the major elements of capacity-development; it is focused on providing skills for using satellite data and products and should be considered of prime importance for both satellite operators and users.

Different aspects of user readiness for various target groups for training exist, and it is important to identify the categories needed as these will have different timescales and require different levels of information about the new satellite system.

The first type of training focuses on making sure the data can be accessed/received and displayed and is directed towards technical staff, including engineers and information technology specialists. This training addresses the questions: How and where can data and products be accessed? What types of commercial software or freeware programs/software codes are available to read data formats and where are they located?

The second type of training focuses on the research to operations to research loop. It includes testbed and proving ground activities. The overall goal is to evaluate the usefulness of the data or the products in a simulated operational setting and to make sure the data/products can be handled when they become available. This training typically consists of workshops or direct research/office interactions and is conducted with proxy data before satellite launches or with real data after the launches.

The third type of training focuses on the application of the new imagery and products in the operational setting. The generic satellite skills and knowledge necessary for operational forecasters should align with the WMO [*Guidelines on Satellite Skills and Knowledge for Operational Meteorologists*](#) (WMO-No. SP-12) to inform training development, implementation, and impact assessments, particularly as they relate to imagery interpretation. This type of training takes many forms: workshops, webinars, online modules, short reference videos and guides, and so forth. It should take place as close to the release of the new imagery and products as possible, and the best time to enhance information retention is after the launch of the satellite, when the user begins to explore the new imagery and products. Following up one-time formal training with regular and repeated informal training on imagery and products used for different weather phenomena and significant events will increase the adoption of new satellite products by user organizations.

A non-exhaustive list of identified training subjects includes:

- (a) Similarities and differences with respect to existing satellites;
- (b) Equipment operation and maintenance;
- (c) Interpretation of L1 data from satellite payload instruments including:
 - (i) Imagery interpretation;
 - (ii) Passive sounder data usage;
 - (iii) Active instrument usage;
- (d) The use of software tools (for processing, visualization, analysis and assimilation);
- (e) Derived L2 product utilization and interpretation;
- (f) Understanding data formats and dissemination;
- (g) The physical basis of remote sensing, in particular as it applies to new instruments.

Target groups for training include:

- (a) Trainers (using the “Train-the-Trainers” approach);
- (b) Managers of user-readiness projects;
- (c) Operational forecasters;
- (d) User communities in NWP and other application areas;
- (e) Organizational managers;
- (f) Technical support personnel;
- (g) Research and development personnel, and science-to-operations personnel.

The approach to organizing training depends very much on the needs and capabilities of the user organizations and on the organizational relationship between the satellite operators and the users. In 2020, the WMO Education and Training Office published [Global Campus Innovations](#) (WMO-No. ETR-27), which includes submissions from WMO Members on new learning approaches, curriculum advances, collaborations in education and training, and technology-enhanced learning. With these advances, the emphasis is shifting towards blended learning approaches that combine in-person courses and workshops, online self-study modules, webinars, peer-to-peer and mentor interactions, and informal regular regional focus group sessions that promote communities of practice and continued learning.

The increasing importance of continuing training activities after satellite launch needs to be emphasized. Training needs to cover both normal and critical real-weather situations for all seasons, and it must be based on the real characteristics of the satellite systems. Emphasis should also be given to management support of the blended learning approaches and Training for Trainers to enhance the development and delivery of training materials.

The new-generation GEO satellites launched in 2015–2025 have strong similarities in instrumentation (for example, similar spectral, temporal and spatial resolution of imagers and lightning mappers). Therefore, there are substantial potential benefits to users and satellite operators in developing common training material and in fostering common application development.

The WMO-CGMS Virtual Laboratory for Education and Training in Satellite Meteorology (VLab) strategy covering the period 2024–2027 places high emphasis on building capacity among

WMO Members for understanding and exploiting data from new-generation satellites. VLab is expected to play a key role over the coming years in addressing the training needs of meteorologists in this regard, and strong support from CGMS members will be required.

Capacity- development should engage not only operational forecasters and satellite operators, but also the academic community. It is important to ensure that researchers and students participate in scientific activities related to the new instruments, in particular since this will benefit the operational exploitation of the instruments in the longer term by engaging the next generation of developers and users. In order to exploit the innovation potential of next-generation data, early engagement with the research community and their funding agencies is encouraged. Bringing together operational forecasters, product developers, the academic community and forecast users will contribute significantly to the rapid transition from research to operations and vice versa.

Training and user support is required beyond the user preparation phase. The user preparation phase is one period of activity within a broader and sustainable user engagement and capacity-building process.

6. Satellite system development

The activities involved in executing a satellite system development programme are usually divided into the following seven phases (see the figure) and are typically performed by satellite operators in cooperation with research and development satellite agencies and industry partners.

- (a) Phase 0 – Mission analysis and needs identification;
- (b) Phase A – Feasibility;
- (c) Phase B – Preliminary definition;
- (d) Phase C – Detailed definition;
- (e) Phase D – Qualification and production;
- (f) Phase E – Utilization;
- (g) Phase F – Disposal.

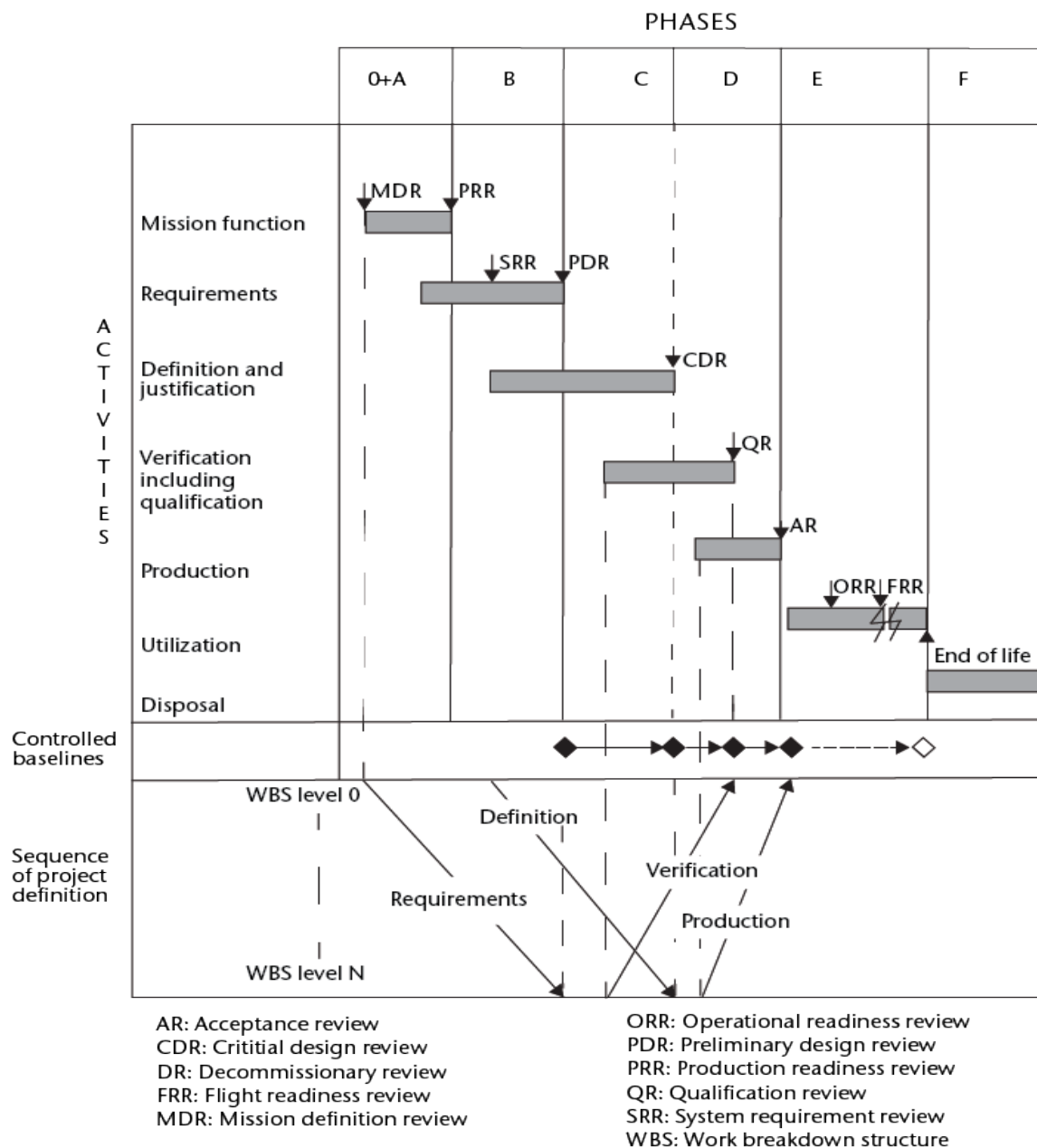


Figure. Reference satellite system development life cycle according to the European Cooperation for Space Standardization

Phase C (detailed definition) concludes with the system critical design review (CDR), at which point the definition of the system (satellite and ground segment) is complete down to the lowest level, and after which, full production (Phase D – qualification and production) of the system will start. If the development follows a nominal schedule, the system CDR will take place three years before the launch of the satellite. Phase E (utilization) starts with the shipment of the satellite to the launch site and the start of launch preparations and is subdivided into Phase E1 (launch and commissioning), typically lasting until 6–12 months after launch, and Phase E2 (routine operations).

The most significant consequence of this life cycle, with respect to the user community, is that the system specifications and other information made available to the user community before the system CDR (at the end of phase C) will be based on the requirements, whereas the deliverables based on the real characteristics of the system will only become available after this time, during Phases D and E1.

This life cycle reflects actual experience relating to Meteosat Second Generation (MSG), Communication, Oceanography and Meteorology Satellite (COMS) and GOES-R and the planning for MTG. Variations exist for specific programmes; for example, the planning for Himawari-8 development was compressed: the system CDR was completed in January 2012, while the satellite was successfully launched on 7 October 2014.

7. Deliverables from satellite development programmes to user-readiness projects

This part of the *Guidelines* considers high-level specifications for the different items produced by the satellite development programmes that should be delivered to user-readiness projects. The timeline of the deliverables can be found in the [table](#).

7.1 Instrument pre-launch calibration and characterization

Pre-launch calibration and characterization data for satellite remote sensing instruments, being of general interest to the remote sensing data user community, are critical for the production of calibrated and geolocated L1 data and their adaptation by NWP and climate applications. The uncertainty, reproducibility and stability of these data are driven by operational and research remote sensing applications and requirements. For instruments built and/or tested by industrial partners, the provision of pre-launch test data to systems engineers, satellite operators and the remote sensing community are often subject to contractual constraints.

Satellite instrument pre-launch testing should strive to reproduce as closely as possible instrument operation in the predicted in-orbit environment. This is also known as “testing as you fly”. The calibration and characterization data produced by this testing ensure that the instrument to be flown is fully understood at launch and will meet its performance requirements when in orbit. The need for pre-launch instrument characterization is all the more important given the increasingly complex design of the new generation of instruments.

Estimates of several key performance parameters (listed below), including SRF characteristics, radiometric accuracies derived from pre-launch tests, and the radiometric characterization of on-board black bodies, will benefit from considering the property of metrological traceability. This requires all measured quantities influencing the estimate of a parameter to be linked, through an unbroken chain of comparisons, to recognized measurement standards, ideally the International System of Units (SI). Establishing such traceability enables the robust determination and optimization of uncertainties in these key performance parameters.

To facilitate their proper and efficient use by the international remote sensing community, pre-launch characterization data should include the following:

- (a) The appropriate channel naming and numbering convention and channel science application(s);
- (b) SRF (also known as relative or absolute radiometric spectral responsivity (RSR)):
 - (i) Channel central frequencies/wavelengths and bandwidths, together with detailed measured spectral responses from pre-launch instrument characterization;
 - (ii) Responsivity versus wavelength as a function of the channel (that is, average) and detector;
- (c) Polarization for each channel, verified by pre-launch measurements;
- (d) Along-scan and in-track FOV pixel size or full point spread function (PSF)/modulation transfer function (MTF);
- (e) Instantaneous field of regard (IFOR)/instantaneous field of view (IFOV)/swath coverage, repeat cycle/orbit configuration;

- (f) Measured antenna pattern (for MW instruments);
- (g) Pixel sampling distance/time intervals;
- (h) System-level instrument noise (that is, noise expressed as a variation in radiance and brightness temperature, noise equivalent change in radiance (NE Δ L) and the noise equivalent differential temperature (NE Δ T), respectively)) as a function of instrument and focal plane temperature and spacecraft voltage;
- (i) Radiometric calibration and characterization:
 - (i) Gain and offset as a function of instrument and focal plane temperature;
 - (ii) Polarization sensitivity;
 - (iii) Radiometric resolution, dynamic range, linearity and quantization;
 - (iv) Response versus scan angle for scanning radiometers;
- (j) Instrument pointing, geometric accuracy and band to band calibration/registration (that is, geometric performance);
- (k) Expected mission and instrument lifetimes;
- (l) Key parameters of on-board calibrators (that is, black-body emissivity and temperature uniformity, solar diffuser spectral bidirectional reflectance or transmittance distribution function (the Bidirectional Reflectance Distribution Function (BRDF) or the Bidirectional Transmittance Distribution Function (BTDF) and uniformity);
- (m) Target and realized measurement uncertainties for the above data;
- (n) In all the above, the level of maturity of the determination of instrument testing parameters should be indicated. This is accomplished by identifying whether the data were determined using analysis/modelling, demonstration or inspection, or testing at the part, subassembly, subsystem, system or observatory (that is, spacecraft plus instruments) level.

Pre-launch test data should be provided for the primary, redundant and all potential cross-strap instrument in-orbit operational configurations.

Mechanisms must be established to provide users with information about events that affect in-flight instrument performance. To address this, the [Global Space-based Inter-calibration System \(GSICS\)](#) project coordinates the implementation of operational instrument event logs.

7.2 Product specifications

Product specifications include scientific specifications of the product algorithms, detailed specifications of formats for dissemination, as well as on-demand requests, information on timeliness and expected data volumes, all for both L1 and L2 products.

Community standard formats should be adopted for products, if not WMO's BUFR and the gridded binary (GRIB), then the Network Common Data Forum (netCDF) with the Climate and Forecast (CF) convention. For the latter, WMO is in the process of introducing netCDF CF profiles, and the concept of WMO-approved formats is evolving in this respect. It is also important to consider the flexibility which will come with the advent of the WMO Information System (WIS) 2.0. There is a need for a more standardized approach to describe both L1 and L2 products, potentially through the development of standard templates for product description. It is highly recommended that nicknames be avoided to describe the products. Nicknames lead to confusion among users (for example, it was reported by trainers that tropical users initially ignored using the "snow/ice" band at 1.6 μ m because they did not experience snow and ice on the ground – they later realized it was useful for detecting the ice phase in clouds).

7.3 *Product guides*

In addition to formal product specifications (for example, algorithm theoretical basis documents (ATBDs)), several operators have successfully implemented product handbooks/user guides which help users assess the fitness for purpose of the products. A good example of these is the MTG product user guides generated by EUMETSAT. The content of these guides includes information that is helpful with respect to receiving, processing, and reading level 0–2 data (for example) and using those data as inputs for algorithms, products, and display systems.

7.4 *Data access mechanism specifications*

With the increasing use of cloud technology, the methods for accessing satellite products are developing rapidly. There is, however, a need for a range of access methods so that users who do not have reliable access to the Cloud can retrieve products reliably.

The methods for accessing satellite products directly typically include DB from the satellite itself and/or digital video broadcast (DVB)-based dissemination from telecommunications satellites. The corresponding specifications are required for the procurement of user reception systems.

The system requirements for DB reception systems, including both antennas, front-end components and computer systems for acquisition and L1 processing, need to be available to users in time for them to start their procurement activities, typically three years before launch. Processing system requirements are becoming increasingly demanding, with the complex processing of DB data for the new generation of satellites, and the impact on users' systems is significant. If the satellite operator can offer a remotely accessible (possibly cloud-based) processing solution for the DB data, the DB reception system will not necessarily need L1 processing capabilities. This approach is already being assessed by the China Meteorological Administration (CMA).

Also required are specifications of other near-real-time dissemination mechanisms employing terrestrial communication and cloud technology, as well as specifications for offline data access mechanisms, including archive retrieval and other on-demand means. For example, for data disseminated via the Global Telecommunication System (GTS), abbreviated bulletin headers are needed to organize the routing, and for data disseminated via the WIS 2.0 publication/subscription (pub/sub) infrastructure, the relevant topic(s) are needed to configure the consumers' subscriptions.

Where user registration is needed for access to products and services, a detailed description of the user registration process is required before launch so that users can carry out the registration process during the commissioning phase.

7.5 *Software tools, documentation, and test data*

Level 1 preprocessing software is required for the development of user data-processing functions, but in many cases, it is only available from an operator after ground segment acceptance. Any contracts for the procurement of data-processing systems need to take this into account to allow for early deliveries.

Software documentation, such as format books, user menus, ATBDs, need to be made available to users along with the software and test data.

Software tools can also be developed by experts in the user community, but for a new generation of satellites, these software tools will always depend on L1 processing kernels developed as part of the satellite system development.

Different categories of test data exist, with different life cycles. A universal categorization is not in use, but for the purposes of these *Guidelines*, the following terminology is used:

- (a) Synthetic data: No scientific value, but realistic sizes and formats; used for user data-flow testing;
- (b) Simulated data: Data simulated by forward radiative transfer model calculations. Simulated data are used to test processing and visualization tools. These data are produced based on NWP-model outputs; they generally do not contain realistic spatial structure and temporal variability;
- (c) Proxy data: Actual data sets from relevant precursor instruments – for example, 2.5 minute data from Meteosat-10 for MTG-Flexible Combined Imager (MTG-FCI), 1 minute super-rapid scanning data from GOES for GOES-R Advanced Baseline Imager (ABI), and Infrared Atmospheric Sounding Interferometer (IASI)/Atmospheric Infrared Sounder (AIRS) data for FY-4A Geostationary Interferometric Infrared Sounder (GIIRS) and MTG-Infrared Sounder (MTG-IRS). Proxy data are used in early training on capabilities and application areas. It is also possible to use proxy data to construct test data similar to simulated data by adding data simulated by radiative transfer models for channels to the data present in precursor missions or by using interpolation in time and space;
- (d) Pre-operational data: Real satellite data generated as part of the commissioning activities, but before full validation has been completed.

The operators should provide all of these categories of test data, use consistent terminology to describe them, and provide software tools for the use of the test data, both during pre-launch development and testing (where the focus should be on data for format familiarization and data-flow testing) and during post-launch commissioning activities (where pre-operational data are to be provided). Advanced users can also provide test data, and these data can be integrated with the test data supplied by the operators.

7.6 Operations plans and schedules

To ensure user readiness, it is important that both long-term plans, as well as routine schedules, be made available before the start of operations. These include the following elements:

- (a) Fly-out plan for the overall satellite programme, including launch plans, orbital positions and end-of-life dates, and information about overlap with existing operational satellites;
- (b) Routine operations schedule, including areas of coverage for flexible scanning operational scenarios and information on the process for scenario switching, for example, activation of super-rapid scanning operations for severe storms and tropical cyclone tracking;
- (c) If appropriate, conditions for user input with respect to the operations schedule (for example, requests for special mode-targeted operations);
- (d) Planning for routine spacecraft maintenance activities, such as orbital manoeuvres, seasonal spacecraft reorientation (yaw-flip), instrument decontamination, and the like;
- (e) Schedules for activation of LEO DB where applicable;
- (f) Schedules for routine dissemination for both DB and re-broadcast via telecommunications satellites.

Dialogue with key users is crucial when establishing the initial operations plans.

Details on recommended due-by dates are provided in the timeline contained in the [table](#).

7.7 Data access during early mission phases

A critical element for ensuring user readiness is the early provision of satellite products and the overlap with the previous system. Satellite products must be provided at the earliest opportunity following the necessary calibration-validation activities, and the data provision must, in all phases, as far as possible, use the operational data access infrastructure. A sufficient overlap with the existing operational satellite system must be provided to support the operational introduction of the new satellite data. The critical needs are:

- (a) Periods of pre-launch dissemination of test data to support the testing of users' data acquisition infrastructure;
- (b) Access to non-validated data by selected users supporting calibration-validation activities;
- (c) Early post-launch dissemination of pre-validated data and products;
- (d) Parallel L1 data dissemination, from both old and new satellites (as long as possible, but for a minimum of six months after the end of commissioning (typically until L+1y))

More details are included in the reference user-readiness project timeline.

7.8 User notification and feedback

It is essential that the satellite operator establish two-way communication channels with the user community to provide general and specific information and to allow users to make enquiries and provide other feedback during the preparation phase. Such channels are also necessary to provide routine user support starting from the commissioning phase and continuing throughout the routine operations phase. Identifying and mapping the networks that reach different user communities allows for strategic and efficient communication.

Such communication should include, but is not limited to, the WMO regional coordination groups on satellite data requirements, regional forums and user conferences, and training events. The communication channels should also provide support for enquiries and feedback from individual users.

7.9 Training resources

For new satellite systems, the provision of training material from satellite operators is crucial. Blended training approaches are of increasing importance and provide flexibility when delivering new information about the satellite and its applications as it becomes available. It is also essential to capitalize on the contributions of the user community and promote training resources that are made available by user groups. WMO-CGMS VLab plays a key role in developing and delivering online training material to users worldwide in their native languages. Regional forums and user conferences held annually or every other year by satellite operators provide the best opportunity to deliver information on new-generation satellites and gather user input to inform the requirements of the next generation of satellites. Training workshops are coordinated with the conferences and can be targeted to specific user groups. Blending and interleaving workshops, courses, webinars, online modules, blogs, and regular regional focus group sessions promotes continued learning and the uptake of satellite imagery and products. VLab is actively engaged in these activities.

7.10 Other deliverables

For many applications, it is important to have the set of fundamental constants that have been used to derive satellite data and products; satellite operators should make these constants available to users. The proposal of a common standard to be used by CGMS operators is planned.

8. Timeline for the reference user-readiness project

The [table](#) shows the overall timeline of user preparedness activities and the planning for the different deliverables needed to support these activities starting from the initial stages of satellite system development.

Table. Timeline for the reference user-readiness project

<i>Time relative to launch date (L) in years (y) or months (m)</i>	<i>Satellite system development: Activities and milestones</i>	<i>User-readiness project: Activities and milestones</i>	<i>Needed deliverables from satellite operators</i>
L-5y -> L-4y	Ground segment development Phase C	- Initiation of user (for example, NMHS)-readiness project - Initiation of cooperative projects addressing needs of less developed WMO Members	- Identified likely and potential users - Overall specifications of user segment, including high-level definition of migration path from existing user segment - Preliminary schedule for deliverables to users - Identified research and development needs (observation operators/radiative transfer, and so forth)
L-4y -> L-3y	System CDR	- Identification of drivers for investment and running costs - Planning and allocation of human resources and budgets for investments and running costs - Establishment of prioritized data requirements, as clear priorities for current and future products allow the best preparations to be made for establishing data access and delivery capabilities - Initial training on capabilities for trainers and decision-makers	- General description of instruments - General description of near-real-time dissemination mechanisms - Detailed specifications of L2 and L1 products to be available at start of operations (Day-1 products) - Proxy test data - Plans for evolution of products after start of operations (Day-2 products)
L-3y -> L-2y	- System production - On-ground characterization of instruments	- Design of new reception system - Design of communications network changes, including GTS/Regional Meteorological Data Communication Network (GTS/RMDCN) capacity - Design of new data-handling and processing functions - Training on specific application areas, based on proxy data, for trainers and senior forecasters	- Specifications of instruments and their performance, including planned SRFs, noise and FOV size - Simulated test data - Developed applications where required (for example, observation operators, methodologies, and so forth) - Detailed specifications of near-real-time dissemination mechanisms - Detailed specifications of DB, including frequency and signal characteristics, and hardware specifications for antennas, front-end components and computer systems for the acquisition and processing of DB data - General description of offline data access - Data/product volume estimates - Data/product format definitions - Fundamental constants used in processing

<i>Time relative to launch date (L) in years (y) or months (m)</i>	<i>Satellite system development: Activities and milestones</i>	<i>User-readiness project: Activities and milestones</i>	<i>Needed deliverables from satellite operators</i>
			- Data access conditions (for example, licensing, key units) - L1 preprocessing software for DB (preliminary version) - Establishment and use of two-way communication channels for user enquiries
L-2y -> L-1y	Ground system acceptance	- Procurement, installation and acceptance testing of systems - Software design for data processing, including NWP ingest - Training on specific application areas, based on proxy data, for trainers and senior forecasters	- Full pre-launch instrument characterization information (including SRFs, noise) - Information on radiative transfer models (for example, RTTOV) that support instruments - Synthetic test data (including L1B data format details, satellite identifier, navigation information) - Continuous periods of test dissemination of synthetic data - Long-term operations plan - Planning for data exchange to serve the global community
L-1y -> L-6m	Flight readiness of satellite	End-user training (forecasters)	- Start of regular updating of plans for launch and commissioning
L-6m -> L	Operational system validation and launch preparations	- Data-processing software testing (using proxy data) - Technical training on reception systems and other system elements - Data acquisition system testing (using synthetic data)	- Simulated test data based on pre-launch instrument characterization - L2 data format - DB software package (if DB available) - User documentation for dissemination mechanisms and delivered software tools - Routine operations schedule
L -> L+6m	- Satellite in-orbit verification - Commissioning of L1 products	- Full system and software testing (using pre-operational data) - Support to operators' calibration/validation activities, in particular through NWP assimilation	- Early dissemination of unvalidated L1 data - Early switch-on of DB - Pre-operational L1 data dissemination - In-flight characterization of instrument performance - L1 preprocessing software for DB (operational version) - Start of routine user support
L+6m -> L+2y	Commissioning of L2 products	- Scientific data exploitation (iterative, based on an increased understanding of real data) - Post-launch training based on real data - Declaration of user operational readiness	- Operational L1 data dissemination from both old and new satellites (as long as possible, but at least until L+1y)

Резолюция 7 (ИНФОМ-3)

Обновление Руководства по приборам и методам наблюдений (ВМО-№ 8)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 2 \(Кг-19\)](#) «Стратегический план ВМО на 2024—2027 гг.»,
- 2) [резолюцию 47 \(Кг-19\)](#) «Обязательные публикации ВМО и политика в области распространения на девятнадцатый финансовый период»,
- 3) [резолюцию 22 \(ИС-76\)](#) «Публикация и перевод *Руководства по приборам и методам наблюдений* (ВМО-№ 8)»,

приняв во внимание обновленные варианты многочисленных глав [Руководства по приборам и методам наблюдений](#) (ВМО-№ 8), подготовленные после второй сессии Комиссии по инфраструктуре, включая:

- 1) новую главу 4 об измерении многолетней мерзлоты в томе II;
- 2) значительный пересмотр главы 6 тома I — «Измерение осадков»;
- 3) частичный пересмотр главы 7 тома I — «Измерение радиации»;
- 4) незначительный пересмотр главы 1 тома II — «Общие положения»;
- 5) незначительный пересмотр главы 5 тома III — «Специальные методы профилирования атмосферного пограничного слоя и тропосферы»,

изучив результаты рассмотрения Членами,

принимает поправки и обновленную информацию к [Руководству по приборам и методам наблюдений](#) (ВМО-№ 8), доступные [здесь](#);

рекомендует Исполнительному совету подтвердить важность того, чтобы Генеральный секретарь приняла меры для публикации *Руководства* к концу 2024 года и изыскала ресурсы для перевода нового издания *Руководства* на все языки ВМО за счет средств регулярного бюджета и/или добровольных взносов;

далее рекомендует Исполнительному совету:

- 1) уполномочить Генерального секретаря:
 - a) вносить любые последующие поправки чисто редакционного характера;
 - b) обновить ссылки на предыдущие технические комиссии в [Руководстве по приборам и методам наблюдений](#) (ВМО-№ 8), указав соответствующие органы;
 - 2) предложить Членам:
 - a) представлять Генеральному секретарю свои предложения относительно того, каким образом совершенствовать последующие версии *Руководства*;
 - b) вносить добровольные взносы для поддержки своевременной публикации *Руководства* на английском языке и на других официальных языках ВМО.
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Резолюция 8 (ИНФОМ-3)

Обновление Руководства по передовой практике использования оперативных метеорологических радиолокаторов (ВМО-№ 1257)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 2 \(Кг-19\)](#) «Стратегический план ВМО на 2024—2027 годы»,
- 2) [резолюцию 47 \(Кг-19\)](#) «Обязательные публикации ВМО и политика в области распространения на девятнадцатый финансовый период»,
- 3) [резолюцию 31 \(ИС-76\)](#) «Публикация и перевод *Руководства по передовой практике использования оперативных метеорологических радиолокаторов*»,

рассмотрев новые тома, подготовленные для Руководства по передовой практике использования оперативных метеорологических радиолокаторов (ВМО-№ 1257) после второй сессии Комиссии по инфраструктуре, включая:

- 1) том IV «Размещение, конфигурация и стратегии сканирования метеорологических радиолокаторов»;
- 2) том V «Калибровка, мониторинг и обслуживание метеорологических радиолокаторов»;
- 3) том VI «Обработка данных метеорологических радиолокаторов»,

изучив результаты рассмотрения Членами,

принимает текст предварительного издания Руководства по передовой практике использования оперативных метеорологических радиолокаторов (ВМО-№ 1257) 2024 года, доступный [здесь](#);

рекомендует Исполнительному совету вновь подтвердить важность того, чтобы Генеральный секретарь приняла меры для публикации *Руководства* к концу 2024 года и изыскала ресурсы для перевода нового издания *Руководства* на все языки ВМО за счет средств регулярного бюджета и/или добровольных взносов:

- 1) уполномочить Генерального секретаря вносить любые последующие поправки чисто редакционного характера;
- 2) предложить Членам:
 - а) представлять Генеральному секретарю свои предложения относительно того, каким образом совершенствовать последующие версии *Руководства*;
 - б) вносить добровольные взносы для поддержки своевременной публикации *Руководства* на английском языке и на других официальных языках ВМО;

порукает Постоянному комитету по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП) и Постоянному комитету по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ) осуществлять дальнейшее обновление *Руководства* и внесение в него поправок, по мере необходимости, предоставляя тем самым Членам самые последние руководящие принципы по оперативным метеорологическим радиолокаторам и обеспечивая согласованность с содержанием [Руководства по приборам и методам наблюдений](#) (ВМО-№ 8) и других соответствующих публикаций ВМО.

Резолюция 9 (ИНФОМ-3)

Обновление Руководства по гидрологической практике, том I (ВМО-№ 168)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

напоминая о том, что *Руководство по гидрологической практике, том I — Гидрология: от измерений до гидрологической информации* (ВМО-№ 168) (далее именуемое «Руководство») дает общее представление о текущей оперативной гидрологической практике, процедурах и измерительных приборах (от измерения расхода воды до прогнозирования и регулирования), которые могут быть использованы национальными гидрологическими службами Членов для осуществления положений, содержащихся в *Техническом регламенте, том III: Гидрология* (ВМО-№ 49),

приняв во внимание, что последняя редакция *Руководства* была опубликована в 2008 году, и поэтому самые последние достижения в области технологий и практики, применяемых в гидрологии, не нашли надлежащего отражения в тексте,

отмечая, что Объединенная экспертная группа по гидрологическому мониторингу (ОЭГ-ГИДМОН) и Постоянный комитет по гидрологическому обслуживанию (ПК-ГИД) Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) при поддержке Секретариата провели предварительный обзор наиболее срочных тем для пересмотра, обновления и добавления, подчеркивая полное отсутствие, в частности, ссылок на методы измерения расхода воды с помощью изображений,

отмечая далее ответственность Генерального секретаря за публикацию принятых изданий, включенных в [резолюцию 47 \(Кг-19\)](#) «Обязательные публикации ВМО и политика в области распространения на девятнадцатый финансовый период», включая любые последующие поправки чисто редакционного характера,

принимает предложенные обновления *Руководства по гидрологической практике, том I* (ВМО-№ 168), в виде нового раздела 5.3.7.6 «Методы измерения расхода воды с помощью изображений», как указано в дополнении к настоящей резолюции;

порукает своим постоянным комитетам периодически пересматривать *Руководство* в части их компетенции и мандата, а также в сотрудничестве с СЕРКОМ, и обновлять его по мере необходимости.

Дополнение к резолюции 9 (ИНФОМ-3)

5.3.7.6 Методы измерения расхода воды с помощью изображений

Методы измерения с помощью изображений могут использоваться для малозатратного и эффективного отслеживания трассеров на последовательных кадрах, результаты которого затем преобразуются в скорость потока на поверхности с помощью временного интервала между кадрами. Среди широкого разнообразия подходов методы измерения поверхностной скорости с помощью изображений можно разделить на следующие категории (ISO 748, 2021):

- методы измерения скорости по изображениям частиц (PIV) (также именуемые методами измерения скорости по крупномасштабным изображениям частиц (LSPIV), когда они применяются в масштабах рек (Fujita et al. 1994 и Muste et al. 2008)) основаны на алгоритмах взаимной корреляции (сопоставления рисунков) и хорошо подходят для потоков с плотными естественными трассерами, такими как турбулентные образования или пена;

- измерение скорости на основе отслеживания частиц (PTV) (Lloyd, Stans by, & Ball, 1995) представляет собой метод Лагранжа, который используется для отслеживания траекторий твердых и разреженных трассеров, например в селевых потоках или при введении искусственных трассеров;
- в других оптических методах исследования потока для получения распределения скоростей используется видимый сдвиг яркостных рисунков на изображении (Barron, Fleet, Beauchemin, & Burkitt, 1994);
- метод измерения скорости с помощью изображений трассера в пространственно-временной системе координат (STIV) (Fujita, Watanabe, & Tsubaki, 2007) позволяет провести одномерные измерения скорости на поверхности по нескольким линиям анализа, расположенным перпендикулярно поперечнику. Скорости рассчитываются на основе комбинированных изображений каждой линии в пространственно-временной системе координат с формированием уголкового рисунка на основании перемещения трассера по поверхности с течением времени и в пространстве.

PIV, PTV и другие оптические методы исследования потока позволяют получать двумерные значения мгновенных поверхностных скоростей на больших площадях. STIV представляет собой надежный метод оценки скорости, когда частицы трассера имеют минимальный размер и расположены разреженно. Независимо от используемого метода, должны выполняться одни и те же этапы обработки:

- i) видеозапись участка реки;
- ii) предварительная обработка видеозаписи (стабилизация, подвыборка, улучшение изображения, регистрация изображений и т. д.);
- iii) орторектификация изображений для исправления перспективных искажений и масштабирования изображений в мировой системе координат;
- iv) определение скорости на поверхности путем отслеживания проявления видимых закономерностей с течением времени и в пространстве, как описано в каждом методе (примечание: этапы iii) и iv) являются взаимозаменяемыми);
- v) последующая обработка (в основном фильтрация и осреднение по времени); и
- vi) расчет расхода воды. Для расчета расхода воды требуется батиметрия поперечного сечения и уровень воды с одного или нескольких секторов, а также действующий метод или предположение для преобразования поверхностной скорости в скорость, осредненную по глубине.

Видеозапись может осуществляться с помощью стационарных камер, ручных камер (или камер в смартфонах) и беспилотных летательных аппаратов (БЛА, или дронов) в зависимости от доступности оборудования и размера участка реки, на котором проводится исследование. Возможна обработка видеозаписей, полученных от непрофессиональных наблюдателей, особенно в рамках оценочных исследований после паводков (Boursicaud et al. 2016, Le Coz et al. 2016). Камеры с цветовоспроизведением с помощью красного, зеленого и синего цветов в видимом спектре (RGB) экономичны, просты в приобретении и позволяют получить изображения с относительно высоким разрешением, но их действие ограничено излучением в видимой части спектра, и они не могут быть использованы для получения изображений в ночное время без внешнего источника света. Ночные измерения можно проводить с помощью камер для съемки в ближней области инфракрасного излучения (NIR) (могут потребоваться дополнительные источники света ближнего ИК-диапазона). Примером могут служить камеры-ловушки или некоторые RGB-камеры с удаленным фильтром NIR (Hutley et al., 2023). Высочайшее качество измерения поверхностных скоростей с помощью изображений достигается при использовании высокоэффективных тепловизионных инфракрасных (т. е. длинноволновых инфракрасных) камер (Schweitzer & Cowen, 2021). Их можно применять как днем, так и ночью, а в качестве трассеров при этом используются незначительные температурные

различия в поверхностных слоях воды. Будучи эффективными, эти камеры в настоящее время являются слишком дорогостоящими и хрупкими для повседневного использования.

Орторектификация обеспечивается путем простого геометрического масштабирования в случае видеозаписи, сделанной с помощью БЛА, направленного в нади́р, или с помощью более сложных двухмерных или трехмерных фотограмметрических уравнений для острых углов. Для орторектификации требуются наземные контрольные точки (НКТ — точки с известными мировыми координатами, которые видимы на снимках) или знание внутренних и внешних параметров камеры. НКТ — это идентифицируемые объекты на видео, которые могут быть исследованы для получения необходимых координат XYZ. НКТ могут быть исследованы до или после осуществления видеозаписи и должны быть видны на изображении (т. е. их размер должен превышать минимальный размер пикселя при полном разрешении). Данные НКТ в системе координат XYZ обеспечивают калибровку между координатами пикселей и реальными координатами, которая остается действительной для всех видеозаписей при фиксированной установке камеры, когда разрешение, масштабирование, угол тангажа, крен и рысканье камеры остаются неизменными. Это позволяет обрабатывать видеозапись даже тогда, когда НКТ перестают быть видимыми, например когда они находятся под водой во время паводков.

Для расчета расхода воды с помощью методов, основанных на изображениях, необходимо знать осредненные по глубине скорости, уровень воды (глубину или уровень) и батиметрию поперечного сечения, которые либо измеряются отдельно, либо оцениваются. Другие методы измерения поверхностных скоростей, такие как использование буюв, приповерхностных измерителей скорости потока и радиолокаторов, позволяют получить скорость на поверхности в той или иной точке, но также могут быть использованы для оценки расхода воды. Поверхностные скорости обычно соотносятся с осредненными по глубине скоростями через коэффициент перевода, часто именуемый коэффициентом альфа (Biggs et al. 2021). В методах измерений с помощью изображений используется расчет расхода воды скорость-площадь на основе методы элементарных площадок или метода серединных площадок, что, таким образом, в значительной степени соответствуют рекомендациям, изложенным в ИСО 748. Основные источники неопределенности для методов расчета с помощью изображений включают в себя: измерение поперечного сечения (особенно в связи с паводками), коэффициент альфа, уровень воды, орторектификация (Le Coz et al, 2021).

В последнее время наблюдается значительный прогресс в использовании методов PIV в инновационных целях, включая применение алгоритмов PIV для измерения скорости речного потока с помощью изображений, полученных с движущегося воздушного судна, (MARV) (Legleiter et al, 2023) и использование методов измерения скорости по крупномасштабным изображениям частиц для малых беспилотных авиационных систем (БАС) для измерения поверхностной скорости потока и расхода воды (Duan et al, 2023). Кроме того, недавно было разработано программное обеспечение с открытым исходным кодом для обработки изображений с целью облегчения оценки поверхностной скорости потока в речных руслах по данным дистанционного зондирования: инструментарий для измерения скорости речного потока с использованием изображений, полученных с воздушного судна (TRiVIA) (Legleiter and Kinzel, 2024; Legleiter 2024).

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Резолюция 10 (ИНФКОМ-3)

Обновление Руководства по Информационной системе ВМО (ВМО-№ 1061)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 25 \(Кг-19\)](#) «Технический регламент Информационной системы ВМО 2.0»;
- 2) [резолюцию 34 \(ИС-76\)](#) «Обновление Плана осуществления Информационной системы ВМО 2.0»,

признавая необходимость создания консолидированного свода технических регламентов и руководств, которые позволят Членам подготовиться к оперативному внедрению Информационной системы ВМО (ИСВ) 2.0 начиная с января 2025 года,

рассмотрев обновление [Руководства по Информационной системе ВМО](#) (ВМО-№ 1061), подготовленное Постоянным комитетом по управлению информацией и информационным технологиям (ПК-УИИТ) и представленное в дополнении к настоящей резолюции,

приветствует успешное завершение пилотного этапа ИСВ 2.0, о чем сообщается в документе INFCOM-3/ INF. 8.3(2b);

принимает обновление [Руководства по Информационной системе ВМО](#) (ВМО-№ 1061), представленное ПК-УИИТ и содержащееся в дополнении к настоящей резолюции.

Дополнение к резолюции 10 (ИНФКОМ-3)

Guide to the WMO Information System

Divide the [Guide to WMO Information System](#) (WMO-No. 1061) into two volumes.

Volume II contains the WIS 2.0 and

Volume I is the current Guide.

- *Guide to WIS Volume II. WIS 2.0;*
- *Guide to the WIS Volume I*

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Guide to WMO Information System Volume II

WMO Information System 2.0

Introduction

Purpose

In conjunction with the *Manual on the WMO Information System* (WMO-No. 1060), Volume II (Manual on WIS, Volume II: WIS 2.0), the present Guide to the WMO Information System, Volume II (Guide to WIS, Volume II: WIS 2.0) is designed to ensure adequate uniformity and standardization in the data, information and communication practices, procedures and specifications employed by Members of the World Meteorological Organization (WMO) in the operation of the WMO Information System WIS 2.0 as it supports the mission of the Organization. The Manual on WIS contains standard and recommended practices, procedures, and specifications. The Guide to WIS contains additional information concerning practices, procedures, and specifications that Members are invited to follow or implement in establishing and conducting their arrangements in compliance with the WMO Technical Regulations and in developing meteorological and hydrological services.

PART I

1.1 Introduction to WIS2

Since the Global Telecommunication System (GTS) entered operational life in 1971, it has been a reliable real-time exchange mechanism of essential data for WMO Members.

In 2007, the WMO Information System (WIS) entered operations to complement the GTS, providing a searchable catalogue and a Global Cache to enable additional discovery, access, and retrieval. The success of WIS was limited as the system only partially met the requirement of providing simple access to WMO data. Today's technology developed for the Internet of Things (IoT) opens the possibility of creating a WIS2 able to stand to its expectations of delivering an increasing number and volume of real-time data to WMO centres in a reliable and cost-effective way.

WIS2 has been designed to meet the shortfalls of the current WIS and GTS, support the WMO's Unified Data Policy and the Global Basic Observing Network (GBON), and meet the demand for high data volume, variety, velocity, and veracity.

WIS2 technical framework is based around three foundational pillars: leveraging open standards, simpler data exchange and cloud-ready solutions.

1.1.1 Leveraging open standards

WIS2 leverages open standards to take advantage of the ecosystem of technologies available on the market and avoid building bespoke solutions that can force National Meteorological and Hydrological Services (NMHSs) to procure costly systems and equipment. In today's standards development ecosystem, standards bodies work closely together to minimize overlap and build on one another's areas of expertise. For example, the World Wide Web Consortium provides the framework of Web standards, which the Open Geospatial Consortium and other standards bodies leverage. WIS2 leverages open standards with industry adoption and wider, stable, and robust implementations, thus extending the reach of WMO data sharing and lowering the barrier to access by Members.

1.1.2 Simpler data exchange

WIS2 prioritizes public telecommunication networks, unlike private networks for GTS links. As a result, using the Internet will enable the best choice for a local connection, using commonly available and well-understood technology.

WIS2 aims to improve the discovery, access and utilization of weather, climate, and water data by adopting Web technologies proven to provide a truly collaborative platform for a more participatory approach. Data exchange using the Web also facilitates easy access mechanisms. Browsers and search engines allow Web users to discover data without specialized software. The Web also enables additional data access platforms, e.g. desktop Geographical Information System (GIS), mobile applications, forecaster workstations, etc. The Web provides access control and security mechanisms that can be utilized to freely share the Core data per the WMO Unified Data Policy and protect the data with more restrictive licensing constraints. Web technologies also allow for authentication and authorization for the provider to retain control of who can access published resources and to request users to accept a license specifying the terms and conditions for using the data as a condition for providing access to them.

WIS2 uses a "publish-subscribe" pattern where users subscribe to a topic to receive new data in real-time. The mechanism is like WhatsApp and other messaging applications. It is a reliable and straightforward way to allow the user to choose her data of interest and to receive them reliably.

1.1.3 Cloud-ready solutions

The cloud provides reliable platforms for data sharing and processing. It reduces the need for expensive local IT infrastructure, which constitutes a barrier to developing effective and reliable data processing workflows for some WMO Members. WIS2 encourages WMO centres to adopt cloud technologies where appropriate to meet their users' needs. While WMO Technical Regulations will not mandate cloud services, WIS2 will promote a gradual adoption of cloud technologies that provide the most effective solution.

The cloud-based infrastructure allows easy portability of technical solutions, ensuring that a system implemented by a specific country can be packaged and deployed easily in other countries with similar needs. In addition, using cloud technologies allows WIS2 to deploy infrastructure and systems efficiently with minimum effort for the NMHSs by shipping ready-made services and implementing consistent data processing and exchange techniques.

It should be clear that hosting data and services on the cloud does not affect data ownership. Even in a cloud environment, organizations retain ownership of their data, software, configuration, and change management as if they were hosting their infrastructure. As a result, data authority and provenance stay with the organization, and the cloud is simply a technical means to publish the data.

1.1.4 Why are Datasets so important?

WMO enables the international exchange of observations and model data for all Earth system disciplines.

The WMO Unified Data Policy, [Resolution 1 \(Cg-Ext\(2021\)\)](#) describes the Earth system data that are necessary for efforts to monitor, understand and predict the weather and climate – including the hydrological cycle, the atmospheric environment and space weather.

WIS is the mechanism by which this Earth system data is exchanged.

Common practice when working with data is to group them into "Datasets". All the data in a Dataset share some common characteristics. The Data Catalogue Vocabulary (DCAT) defines a Dataset as a "collection of data, published or curated by a single agent, and available for access or download in one or more representations" ¹.

Why is this important? The "single agent" (i.e. a single organization) responsible for managing the collection ensures consistency among the data. For example, in a Dataset:

- All the data should be of the same type (e.g. observations from weather stations).
- All the data should have the same license and/or usage conditions.
- All the data should be subject to the same quality management regime – which may mean that all the data is collected or created using the same processes.
- All the data should be encoded in the same way (i.e. using the same data formats and vocabularies).
- All the data should be accessible using the same protocols – ideally from a single location.

This consistency means that one can predict what data is in a Dataset, at least as far as the common characteristics, making it easier to write applications to process the data.

A Dataset might be published as an immutable resource (e.g. data collected from a research programme), or it might be routinely updated (e.g. every minute as new observations are collected from weather stations).

A Dataset may be represented as a single, structured file or object (e.g. a CSV file where each row represents a data record) or as thousands of consistent files (e.g. output from a reanalysis model encoded as many thousands as possible of General Regularly distributed Information in Binary (GRIB) files). Determining the best way to represent a Dataset is beyond the scope of this Guide – there are many factors to consider! The key point here is that we consider the Dataset to be a single, identifiable resource irrespective of how it is represented.

Because we group data into a single, conceptual resource (i.e. the Dataset) we can:

- Give this resource an identifier, and use this identifier to unambiguously refer to collections of data.
- Make statements about the Dataset (i.e. metadata), and infer that these statements apply to the entire collection.

All this means that the Dataset concept is central WIS:

- We publish discovery metadata about Datasets, as specified in the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix F: WMO Core Metadata Profile 2.
- We can search for Datasets that contain relevant data using the Global Discovery Catalogue (see [Global Discovery Catalogue](#)).
- We can subscribe to notifications about updates about a Dataset via a Global Broker (see [Global Broker](#)).

¹ Data Catalogue Vocabulary (DCAT) - Version 2, W3C Recommendation 04 February 2020
<https://www.w3.org/TR/vocab-dcat-2/#Class:Dataset>

- We can access the data that comprises a Dataset from a single location using a well-described mechanism.

It is up to the Data Publisher to decide how their data is grouped into Datasets – effectively, to decide what Datasets they publish to WIS. That said, we recommend that, subject to the consistency rules above, Data Publishers should organize their data into as few Datasets as possible.

For a Data Publisher, this means fewer discover metadata records to maintain. For a Data Consumer this means fewer topics to subscribe to and fewer places to access the data.

There are some things that are fixed requirements for Datasets:

1. All data in the Dataset must be accessible from a single location;
2. All data in the Dataset must be subject to the same license or usage conditions.

Here are some examples of Datasets:

- The most recent 5-days of synoptic observations for an entire country or territory².
- Long-term record of observed water quality for a managed set of hydrological stations.
- Output from the most recent 24-hours of operational numerical weather prediction model runs.
- Output from 6 months of experimental model runs. It is important to note that output from the operational and experimental should not be merged into the same Dataset because they use different algorithms – it is very useful to be able to distinguish the provenance (or lineage) of data.
- A multi-petabyte global reanalysis spanning 1950 to present day.

In summary, Datasets are important because they are how data is managed in WIS.

1.2 Data Consumer

As a Data Consumer wanting to use data published via WIS2 you should read the guidance presented here. In addition, a list of references to informative material in this Guide and elsewhere is provided at the end of this section.

1.2.1 How to search the Global Discovery Catalogue to find Datasets

The first step to using data published via WIS2 is to determine which Dataset or Datasets contains the data that is needed. To do this, a Data Consumer may browse discovery metadata provided by the Global Discovery Catalogue. Discovery metadata follows a standard scheme (see [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix F: WMO Core Metadata Profile 2). A Data Consumer may discover a Dataset using keywords, geographic area of interest, temporal information, or free text. Matching search results from the Global Discovery Catalogue provide high level information (title, description, keywords, spatiotemporal extents, data policy, licensing, contact information), from which a Data Consumer can assess and evaluate their interest in accessing/downloading data associated with the Dataset record.

² Why 5-days in this example? Because the system used to publish the data in this example only retains data for 5-days.

A key component of Dataset records in the Global Discovery Catalogue is that of "actionable" links. A Dataset record provides one to many links that clearly identify the nature and purpose of the link (informational, direct download, API, subscription) so that the Data Consumer can interact with the data accordingly. For example, a Dataset record may include a link to subscribe to notifications (see [How to subscribe to notifications about availability of new data](#)) about the data, or a API, or an offline archive retrieval service.

The Global Discovery Catalogue is accessible via an API and provides a low barrier mechanism (see [Global Discovery Catalogue](#)). Internet search engines are able to index the discovery metadata in the Global Discovery Catalogue, thereby providing Data Consumers with an alternative means to search for WIS2 data.

1.2.2 How to subscribe to notifications about availability of new data

WIS2 provides notifications about updates to Datasets; for example, when a new observation record from an automatic weather station is added to a Dataset of surface observations. Notifications are published on message brokers. Where Data Consumers need to use data rapidly once it has been published (e.g. for input to a weather prediction model), they should subscribe to one or more Global Broker to get notifications messages using MQTT protocol³.

In WIS2, notifications are republished by Global Brokers to ensure resilient distribution. Consequently, there will be multiple places where one can subscribe. Data Consumers requiring real-time notifications must subscribe to Global Brokers. A Data Consumer should subscribe to more than one Global Broker, thereby ensuring that notifications continue to be received if a Global Broker instance fails.

A Dataset in WIS2 is associated with a unique *topic*. Notifications about updates to a Dataset are published to the associated topic. Topics are organized according to a standard scheme (see the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix D: WIS2 Topic Hierarchy).

A Data Consumer can find the appropriate topic to subscribe to either by searching the Global Discovery Catalogue, using an Internet search engine⁴, or by browsing the topic hierarchy on a message broker.

WIS2 uses Global Caches to distribute Core data, as defined in the WMO Unified Data Policy ([Resolution 1 \(Cg-Ext 2021\)](#)). Each Global Cache republishes Core data on its own highly available data server and publishes a new notification message advertising the availability of that data from the Global Cache location.

Notifications from WIS2 Nodes and Global Caches are published on different topics: The root topic used by WIS2 Nodes is **origin**, while the root topic used by Global Caches is **cache**. Other than the root, the topic hierarchy is identical. For example, for synoptic weather observations published by Environment Canada:

- Environment and Climate Change Canada, Meteorological Service of Canada's WIS2 Node publishes to: **origin/a/wis2/ca-eccc-msc/data/core/weather/surface-based-observations/synop**.
- Global Caches publish to: **cache/a/wis2/ca-eccc-msc/data/core/weather/surface-based-observations/synop**.

As per clause 3.2.13 of the [Manual on WIS](#) (WMO-No. 1060), Volume II, Data Consumers should access Core data from the Global Caches. Consequently, they need to subscribe to the

³ Subscribing to notifications about newly available data means that you do not need to continually to poll the data server to check for updates.

⁴ Internet search engines allow Data Consumers to discover WIS2 Datasets by indexing the content in the Global Discovery Catalogues.

cache topic hierarchy to receive the notifications from Global Caches, each of which provides a link (i.e. URL) to download from the respective Global Cache's data server.

1.2.3 How to use a notification message to decide whether to download data

On receipt of a notification message, a Data Consumer needs to decide whether to download the newly available data. The content of the notification message provides the information needed to make this decision. For details of the specification, see the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix E: WIS2 Notification Message.

In many cases, Data Consumers will use a software application to determine whether to download the data. This section provides insight about what happens.

When subscribing to multiple Global Brokers the Data Consumer will receive multiple copies of a notification message. Each notification message has a unique identifier, defined using the **id** property. Duplicate messages should be discarded.

Core data will be available from both a WIS2 Node and Global Caches, each of which publish a different notification message advertising alternative location from where the data can be downloaded. Because these are *different* messages, they will have *different* identifiers. However, each of these messages refers to the same data object, which is uniquely identified in the notification message using the **data_id** property. Notification messages from different sources can easily be compared to determine if they refer to the same data. By subscribing to the **cache** root topic, Data Consumers will only receive notifications about data available from the Global Caches. The **origin** root topic should be used when subscribing to notifications about Recommended data. Data Consumers should not subscribe to the **origin** root topic for notifications about Core data because notification messages provided on these topics will refer to data published directly on the WIS2 Nodes (i.e. the "origin").

Data Consumers need to consider their strategy for managing these duplicate messages. From a data perspective, it does not matter which Global Cache instance is used – they will all provide an identical copy of the data object published by the originating WIS2 Node. The simplest strategy is to accept the first notification message and download from the Global Cache instance that the message refers to (i.e. using a URL for the data object at that Global Cache instance). Alternatively, a Data Consumer may have a preferred Global Cache instance, for example, that is in their region. Whichever Global Cache instance is chosen, Data Consumers will need to implement logic to discard duplicate notification messages based on **id** and duplicate data objects based on **data_id**.

A notification message also provides a small number of metadata about the data object it references: Location, time, etc. Data Consumers can use this metadata to decide if the data object referenced in the message should be downloaded. This is known as *client-side filtering*.

The notification message should also include the metadata identifier for the Dataset to which the data object belongs. A Data Consumer can use the metadata identifier to search the Global Discovery Catalogue and discover more about the data – in particular, whether there are any conditions on the use of this data.

1.2.4 How to download data

Links to where data can be accessed are made available through Dataset discovery metadata (via the Global Discovery Catalogue) and/or data notification messages (via Global Brokers). Links can be used to directly download the data (according to the network protocol and content description provided in the link) using a mechanism appropriate to the workflow of the Data Consumer. This could include Web and/or desktop applications, custom tooling, or other approaches.

A discovery metadata record or notification message may provide more than one download links. The preferred link will be identified as "canonical" (link relation: "**rel**": "**canonical**"⁵).

Where data is provided through an interactive Web service, a canonical link that provides a URL where one can directly download a data object may be complemented with an additional link providing the URL for the root of the Web service from where one can interact with or query the entire Dataset.

If a download link implements access control (i.e. where the Data Consumer needs to take some additional action(s) to download the data object), the download link will contain a security object that provides the pertinent information (e.g. the access control mechanism used, and where/how a Data Consumer would need to register to request access).

1.2.5 How to use data

Data is shared on WIS2 in accordance with the WMO Unified Data Policy ([Resolution 1 \(Cg-Ext 2021\)](#)). This data policy describes two categories of data: **Core** and **Recommended**:

- Core data is considered essential for provision of services for the protection of life and property and for the well-being of all nations. Core data is provided on a free and unrestricted basis, without charge and with no conditions on use.
- Recommended data is exchanged on WIS2 in support of Earth system monitoring and prediction efforts. Recommended data *may* be provided with conditions on use and/or subject to a license.

Furthermore, the WMO Unified Data Policy encourages attribution of the source of the data in all cases. In this way, credit is given to those who have expended effort and resources in collecting, curating, generating, or processing the data. Attribution provides visibility of who is using data which, for many organizations, provides necessary evidence to justify continued provision of and updates to the data.

Details of the applicable WMO data policy and any rights or licenses associated with data are provided in the discovery metadata that accompanies the data. Discovery metadata records are available from the Global Discovery Catalogue.

The [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix F: WMO Core Metadata Profile 2, section 7.1.17. Properties / WMO data policy provides details on how data policy, rights, and/or licenses are described in the discovery metadata.

When using data from WIS2, Data Consumers:

- Shall respect the conditions of use applicable to the data as expressed in the WMO data policy, rights statements, or licenses.
- Should attribute the source of the data.

1.2.6 Further reading for data consumers

As a Data Publisher planning to operate a WIS2 Node, as a minimum you should read the following sections:

- [Introduction to WIS2](#)

⁵ IANA Link Relations <https://www.iana.org/assignments/link-relations/link-relations.xhtml>

- [WIS2 Architecture](#)
- [Roles in WIS2](#)
- [Components of WIS2](#)

The following specifications in the [Manual on WIS](#) (WMO-No. 1060), Volume II are useful for further reading:

- Appendix D: WIS2 Topic Hierarchy
- Appendix E: WIS2 Notification Message
- Appendix F: WMO Core Metadata Profile 2

1.3 Data Publisher

As a Data Publisher with authoritative Earth system data that you want to share with the WMO community you should read the guidance presented here. In addition, a list of references to informative material in this Guide and elsewhere is provided at the end of this section.

1.3.1 How to get started

The first thing you need to do is consider your data, how it can be conceptually grouped into one or more Datasets (see 1.1.4 Why are Datasets so important?), and whether it is **Core** or **Recommended** data, as per the WMO Unified Data Policy ([Resolution 1 \(Cg-Ext 2021\)](#)).

Next, you need to consider where it is published. If your data relates to your country or territory, you need to publish it through a National Centre (NC). If your data relates to a region, programme, or other specialized function within WMO, you need to publish it through a Data Collection or Production Centre (DCPC). The functional requirements for NC and DCPC are described in the [Manual on WIS](#) (WMO-No. 1060), Volume II – Part III Functions of WIS.

All NCs and DCPCs are affiliated with a Global Information System Centre (GISC) that has a responsibility to help establish efficient and effective data sharing on the WIS. Your GISC will be able to help you in getting your data onto WIS2.

You may be able to identify an existing NC or DCPC that can publish your data. Alternative, you need to establish a new NC or DCPC. The main difference is that an NC is designated by a member, whereas a DCPC is designated by a WMO or related international programme and/or a regional association.

Both NC and DCPC require operation of a WIS2 Node (see [WIS2 Node](#)). The procedure for registering a new WIS2 Node is provided in [Registration and decommissioning of a WIS2 Node](#).

Once you have determined the scope of your Datasets, the data policy which applies, and have a WIS2 Node ready for data publication, you are ready to progress to the next step: providing discovery metadata.

1.3.2 How to provide discovery metadata to WIS2

Discovery metadata is the mechanism by which you tell potential consumers about your data, how it may be accessed, and any conditions you may place on the use of the data.

Each Dataset you want to publish must have an associated discovery metadata record. This record is encoded as GeoJSON (RFC 7946⁶) must conform to the specification given in the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix F: WMO Core Metadata Profile 2.

Copies of all discovery metadata records from WIS2 are held at the Global Discovery Catalogues, where Data Consumers can search and browse to find data that is of interest to them.

Depending on local arrangements, your GISC may be able to help you transfer your discovery metadata record(s) to the Global Discovery Catalogues. If this is not the case, you will need to publish the discovery metadata record(s) yourself⁷ using one of two ways:

- The simplest method is to encode the discovery metadata record as a file and publish it to an HTTP server where it can be accessed with a URL.
- Alternatively, you may operate a local metadata catalogue through which discovery metadata records can be shared using an API (e.g. Open Geospatial Consortium (OGC) API – Records⁸). Each discovery metadata record can be accessed with a unique URL via the API (e.g. as an item which is part of the discovery metadata catalogue).

In both cases, a notification message needs to be published on a message broker that tells WIS2 there is new discovery metadata to upload and that it is accessed at the specified URL⁹. The notification messages shall conform to the specification given in the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix E: WIS2 Notification Message. Furthermore, the notification message must be published on topic that conforms to the specification given in [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix D: WIS2 Topic Hierarchy. For example, metadata published by Deutscher Wetterdienst would use the following topic: **origin/a/wis2/de-dwd/metadata/core**.

These discovery metadata records are then propagated through the Global Service components into the Global Discovery Catalogue where Data Consumers can search and browse for Datasets of interest.

Upon receipt of a new discovery metadata record, a Global Discovery Catalogue (see [Global Discovery Catalogue](#)) will validate, assess, ingest, and publish the record. Validation ensures that your discovery metadata record complies with the specification. Assessment examines your discovery metadata record against good practice. The Global Discovery Catalogue will notify you if your discovery metadata record fails validation and provide recommendations for improvements for you to consider.

Discovery metadata must be published in the Global Discovery Catalogues before you begin publishing data.

1.3.3 How to provide data to WIS2

WIS2 is based on the Web architecture¹⁰. As such it is *resource oriented*. Datasets are resources; the "granules" of data grouped in a Dataset are resources; the discovery metadata records that describe Datasets are resources. In Web architecture, every resource has a

⁶ RFC 7946 – The GeoJSON Format: <https://datatracker.ietf.org/doc/html/rfc7946>

⁷ In future, WIS2 may provide metadata publication services (e.g. through a WIS2 metadata management portal) to assist with this task. However, such a service is not currently available.

⁸ OGC API – Records – Part 1: Core <https://docs.ogc.org/DRAFTS/20-004.html>

⁹ Both data and metadata publication use the same notification message mechanism to advertise the availability of a new resource.

¹⁰ Architecture of the World Wide Web <https://www.w3.org/TR/webarch/>

unique identifier (e.g. a URI¹¹), and the unique identifier can be used to resolve the resource identified and interact with it (e.g. to download a representation of the resource over an open standard protocol such as HTTP).

Simply, you provide data (and metadata) to WIS2 by assigning it a unique identifier, in this case a URL¹², and making it available via a data server – most typically a Web server using the HTTP protocol¹³. It is up to the data server to decide what to provide when resolving the identifier: the URL of a data granule may resolve as a representation encoded in a given data format, whereas the URL of a Dataset may resolve as a description of the Dataset (i.e. metadata) that includes links to access the data from which the set is comprised – either individual files (i.e. the data granules) or an interactive API that enables a user to request just the parts of the Dataset they need by specifying query parameters.

The following sections cover specific considerations relating to publishing data to WIS2.

1.3.3.1 Data formats and encodings

Whether providing data as files or through interactive APIs you need to decide which encodings (aka. *data formats*) to use. WMO Technical Regulations may require that data is encoded formats. For example, synoptic observations must be encoded in Binary universal form for the representation of meteorological data (BUFR). The *Manual on Codes* (WMO-No. 306) provides details of data formats formally approved for use in WMO. However, Technical Regulations do not cover all data sharing requirements. In such cases, you should select data formats that are open, non-proprietary, and widely adopted and understood in their target user community. In this context, “open” means that anyone can use the format without needing a license to do so – either to encode data in that format or write software that understands the format.

1.3.3.2 Providing data as files

The simplest way to publish data through WIS2 is to persist your data as files and publish those files on a Web server. All these files need to be organized somehow – perhaps a flat structure or grouped into collections that resemble folders or directory structures.

To make your data usable, your users need to be able to find the specific file (or files) they need.

Naming conventions for files and/or directories are useful – but only when the scheme is understood. If your users understand your naming, convention will be a barrier to widespread reuse; many users will simply treat the filename as an opaque string. Where communities commonly use file-naming conventions (e.g. with embedded metadata), these should only be used when adequate documentation is provided to users.

WIS2 does not require the use of specific naming conventions.

Another mechanism to consider is complementing the collections (i.e. directories or folders in which files are grouped) with information that describes their content. Then users, both humans and software agents, can browse the structure and find what they need. Examples of this approach include:

¹¹ RFC 3986 – Uniform Resource Identifier (URI) - Generic Syntax:
<https://datatracker.ietf.org/doc/html/rfc3986>

¹² The term "Uniform Resource Locator" (URL) refers to the subset of URIs that, in addition to identifying a resource, provide a means of locating the resource by describing its primary access mechanism (e.g. its network "location"). RFC 3986

¹³ WIS2 strongly prefers secure versions of protocols (e.g. HTTPS) wherein the communication protocol is encrypted using Transport Layer Security (TLS)

- Web Accessible Folders (WAF) and "README" files: a Web-based folder structure listing the data object files by name, where each folder contains a formatted "README" file describing the folder contents.
- Spatio Temporal Asset Catalogue (STAC)¹⁴: a community standard based on GeoJSON to describe geospatial data files which can be easily indexed, browsed, and accessed. Free and open-source tools present STAC records (one for each data object file) through a Web-based, browse-able user interface.

When publishing collections of data, it is tempting to package content into zip or SIP¹⁵ resources – perhaps even packaging the entire collection, complete with folders, into a single resource. Similarly, WMO formats such as GRIB and BUFR allow multiple data objects (e.g. fields or observations) to be packed into a single file. Only having to download a single resource is convenient for many users, but the downside is that the user must download the entire resource and then unpack/decompress it. The convenience of downloading fewer resources needs to be balanced against the cost of forcing users to download data they may not need. Whatever your choice, you should be guided by common practice in your domain – i.e. only zip, SIP, or pack if your users expect it.

1.3.3.3 Providing interactive access to data with APIs

Interactive data access aims to support efficient data workflows by enabling client applications to request only the data that they need. The advantage with interactive data access is that it provides more flexibility. Data publishers can offer an API structured around how users want to work with the data rather than force them to work with the structure that is convenient for you as a Data Publisher.

But it is more complex to implement. You need a server running software that can:

1. Interpret a user's request;
2. Extract the data from wherever it is stored;
3. Package that data up and send it back to the user.

Importantly, when considering use of interactive APIs to serve your data you need to plan for costs: every request to an interactive API requires computational resources to process.

Based on the experience of data publishers who have been using Web APIs to serve their communities, this Guide makes the following recommendations about interactive APIs:

- First, interactive APIs should be self-describing. A Data Consumer should not need to know, apriori, how to make requests from an API. They should be able to discover this information from the API endpoint itself – even if this is just a link to a documentation page they need to read.
- Second, APIs should comply with Open API¹⁶ version three or later. Open API provides a standardized mechanism to describe the API. Tooling (free and, commercial, etc.) is widely available that can read this metadata and automatically generate client applications to query the API.

¹⁴ Spatio Temporal Asset Catalogue (STAC) <https://stacspec.org/en>

¹⁵ See <https://www.iasa-web.org/tc04/submission-information-package-sip> or end of <https://www.eumetsat.int/formats>

¹⁶ Open API Specification <https://spec.openapis.org/oas/v3.1.0>

- Third, the OGC have developed a suite of APIs¹⁷ (called "OGC APIs") that are designed specifically to provide APIs for geospatial data workflows (discovery, visualization, access, processing/exploitation) – all of which build on Open API. Among these, OGC API – Environmental Data Retrieval (EDR)¹⁸, OGC API – Features¹⁹, and OGC API – Coverages²⁰ are considered particularly useful. Because these are open standards, there is an ever-growing suite of software implementations (both free and proprietary) that support them. We recommend that data publishers assess these open standard API specifications to determine their suitability to for publishing their Datasets using APIs.

Finally, you should consider versioning your API to avoid breaking changes when adding new features. A common approach is adding a *version number* prefix into the API path, e.g. **/v1/service/{rest-of-path}** or **/service/v1/{rest-of-path}**.

More guidance on use of interactive APIs in WIS2 is anticipated in future versions of this Guide.

1.3.3.4 Providing data in (near) real-time

WIS2 is designed to support the data sharing needs of all WMO disciplines and domains. Among these, the World Weather Watch²¹ drives specific needs for the rapid exchange of data to support weather forecasting.

To enable real-time data sharing²², WIS2 uses notification messages to advertise the availability of a new resource – data or discovery metadata – and how to access that resource. Notification messages are published to a queue on a message broker in your WIS2 Node²³ using the MQTT protocol and immediately delivered to everyone subscribing to that queue. A queue is associated with a specific *topic*, such as Dataset.

For example, when a new temperature profile from a radio sonde deployment is added to a Dataset of upper-air data measurements, a notification message would be published that includes the URL used to access the new temperature profile data. Everyone subscribing to notification messages about the upper-air measurement Dataset would receive the notification message, identify the URL, and download the new temperature profile data.

Optionally, data may be embedded in a notification message using a **content** object *in addition* to publishing via the data server. Inline data must be encoded as **UTF-8**, **Base64**, or **gzip**, and must not exceed 4096 bytes in length once encoded.

Notification messages are encoded as GeoJSON (RFC 7946) and must conform to the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix E: WIS2 Notification Message.

The URL used in the notification message should refer only to the newly added data object rather (e.g. the new temperature profile) than the entire Dataset. However, the WIS2 Notification Message specification allows for multiple URLs to be provided. If you are providing your data through an interactive API, you might provide a "canonical" link (designated with

¹⁷ Open Geospatial Consortium OGC API <https://ogcapi.ogc.org/>

¹⁸ OGC API – Environmental Data Retrieval (EDR) <https://ogcapi.ogc.org/edr>

¹⁹ OGC API – Features <https://ogcapi.ogc.org/features>

²⁰ OGC API – Coverages <https://ogcapi.ogc.org/coverages>

²¹ WMO World Weather Watch <https://wmo.int/world-weather-watch>

²² In the context of WIS2, real-time implies anything from a few seconds to a few minutes – not the milliseconds required by some applications.

²³ WIS2 ensures rapid global distribution of notification messages using a network of Global Brokers which subscribe to message brokers of WIS2 Nodes and republish notification messages (see [Global Broker](#)).

link relation: **"rel": "canonical"**²⁴), and an additional link providing the URL for the root of the Web service from where one can interact with or query the entire Dataset.

You should include the Dataset identifier in the notification message (**metadata_id** property). This allows Data Consumers receiving the notification to cross reference with information provided in the discovery metadata for the Dataset, such as the conditions of use specified in the data policy, rights, or license.

Furthermore, if you have implemented controlled access to your data (e.g. the use of an API key), you should include a security object in the download link that provides the pertinent information (e.g. the access control mechanism used, and where/how a Data Consumer would need to register to request access).

To ensure that Data Consumers can easily find the topics they want to subscribe to, data publishers must publish to an authorized topic, as specified in the *Manual on WIS* (WMO-No. 1060), Volume II, Appendix D: WIS2 Topic Hierarchy.

If your data seems to relate to more than one topic, select the most appropriate one. The topic hierarchy is not a knowledge organization system – it is only used to ensure uniqueness of topics for publishing notification messages. Discovery metadata is used to describe a Dataset and its relevance to additional disciplines; each Dataset is mapped to one, and only one, topic.

If the WIS2 Topic Hierarchy does not include a topic appropriate for your data, you should publish on an *experimental* topic. This allows for data exchange to be established while the formalities are considered²⁵. Experimental topics are provided for each Earth system discipline at level eight in the topic hierarchy (e.g. **origin/a/wis2/{centre-id}/data/{Earth-system-discipline}/experimental/**). Data publishers can extend the experimental branch with subtopics as they deem appropriate. Experimental topics are subject to change and will be removed once they are no longer needed. For more information, see *Manual on WIS* (WMO-No. 1060), Volume II, Appendix D: WIS2 Topic Hierarchy, section 7.1.2 Publishing guidelines.

Whatever topic you choose, the discovery metadata you provided to the Global Discovery Catalogue must include subscription links using that topic²⁶. The Global Broker will only republish notification messages on topics specified in your discovery metadata records.

1.3.3.5 Considerations when providing Core data in WIS2

Core data, as specified in the WMO Unified Data Policy (*Resolution 1 (Cg-Ext 2021)*) is considered essential for provision of services for the protection of life and property and for the well-being of all nations. Core data is provided on a free and unrestricted basis, without charge and with no conditions on use.

WIS2 ensures highly available, rapid access to *most* Core data via a collection of Global Caches (see *Global Cache*). Global Caches subscribe to notification messages about the availability of new Core data published at WIS2 Nodes, download a copy of that data, and republish it on a high-performance data server, discarding it after the retention period expires – normally 24-hours²⁷. Global Caches do not provide any sophisticated APIs – they publish notification

²⁴ IANA Link Relations <https://www.iana.org/assignments/link-relations/link-relations.xhtml>

²⁵ The "experimental" topic is necessary for the WIS2 pre-operational phase and future pre-operational data exchange in test mode.

²⁶ The Global Discovery Catalogue will reject discovery metadata records containing links to topics outside the official topic hierarchy.

²⁷ A Global Cache provides short-term hosting of data. Consequently, it is not an appropriate mechanism to provide access to archives of Core data, such as Essential Climate Variables. Providers of such archive data must be prepared to serve such data directly from their WIS2 Node.

messages advertising the availability of data on their cache and allow users to download data via HTTPS using the URL in the notification message.

The URL included in a notification message that is used to access Core data from a WIS2 Node, or the "canonical" URL if multiple URLs are provided, must:

1. Refer to an individual data object; and
2. Be directly resolvable, i.e. the data object can be downloaded simply by resolving the given URL without further action.

A Global Cache will download and cache the data object accessed via this URL.

The Global Caches are designed to support Members efficiently share real-time and near real-time data; they take on the task of making sure that Core data is available to all [on a free and unrestricted basis, as required by the WMO Unified Data Policy \(Resolution 1 \(Cg-Ext\(2021\)\)\)](#).

Unfortunately, Global Caches cannot republish *all* Core data: there is a limit to how much data they can afford to serve. Currently, a Global Cache is expected to cache about 100 GB of [core](#) data each day.

If frequent updates to your Dataset are very large (e.g. weather prediction models or remote sensing observations) you will need to share the burden of distributing your data with the Global Cache operators. You should work with your GISC to determine the highest priority elements of your Core Datasets that will be republished by the Global Caches.

For Core data that is not to be cached, you must set the **cache** property in the notification message to **false**²⁸.

You must ensure that Core data that is not cached is publicly accessible from your WIS2 Node, i.e. with no access control mechanisms in place.

A Global Cache operator may choose to disregard your cache preference – for example, if they feel that the content you are providing is large enough to impede provision of caching services for other Members²⁹. In such cases, the Global Cache operator will log this behaviour. In collaboration with the Global Cache operators, your GISC will work with you to resolve concerns.

Finally, please note that Global Caches are under no obligation to cache data published on *experimental* topics. For such data, the **cache** property should be set to **false**.

1.3.3.6 Implementing access control

Recommended data, as defined in the WMO Unified Data Policy ([Resolution 1 \(Cg-Ext 2021\)](#)), is exchanged on WIS2 in support of Earth system monitoring and prediction efforts and *may* be provided with conditions on use. This means that you may control access to Recommended data.

Access control should use only the "security schemes" for authentication and authorization specified in Open API³⁰.

²⁸ Default value for the **cache** property is **true**; omission of the property will result in the data object being cached.

²⁹ Excessive data volume is not the only reason they may refuse to cache content. Other reasons include too many small files, unreliable download from a WIS2 Node, etc.

³⁰ Open API Security Scheme Object: <https://spec.openapis.org/oas/v3.1.0#security-scheme-object>

Where access control is implemented, you should include a **security** object in download links provided in discovery metadata and notification messages that provide the user with pertinent information about the access control mechanism used and where/how they might register to request access.

Recommended data is never cached by the Global Caches.

Use of Core data must always be free and unrestricted. However, you may need to leverage existing systems with built-in access control when implementing the download service for your WIS2 Node.

Example 1: API key. Your data server requires a valid API key to be included in download requests. The URLs used notification messages should include a valid API key.^{31 32}

Example 2: Presigned URLs. Your data server uses a cloud-based object store that requires credentials to be provided when downloading data. The URLs used in notification message should be *presigned* with the Data Publisher's credentials and valid for the cache retention period (e.g. 24-hours).³³

In both cases, the URL provided in a notification message can be directly resolved without a user, or Global Cache, needing to take additional action such as providing credentials or authenticating.

Finally, note that if you are only publishing Core data, you may be able to entirely rely on the Global Caches to distribute your data. In such cases, your WIS2 Node may use Internet Protocol (IP) filtering to allow access only from Global Services. For more details, see section 2.6 Implementation and operation of a WIS2 Node.

1.3.3.7 Providing access to data archives

There is no requirement for a WIS2 Node to publish notification messages about newly available data – the mechanism is available if needed (e.g. for real-time data exchange). Data archives published through WIS2 do not need to provide notification messages for data unless the user community have expressed a need to be rapidly notified about changes (e.g. the addition of new records into a climate observation archive).

However, notification messages must still be used to share discovery metadata with WIS2. Given that provision of metadata and subsequent updates is likely to be infrequent, it may be sufficient to "handcraft" a notification message and publish it locally on an MQTT broker³⁴ or with help from a GISC. See above for more details on publishing discovery metadata to WIS2.

Note that some data archives are categorized as Core data, for example, Essential Climate Variables. Core data may be distributed via the Global Caches. However, given that these provide only short-term hosting of data (e.g. 24-hours), Global Caches are not an appropriate mechanism to provide access to archives of Core data. The archive must be accessed directly via the WIS2 Node.

³¹ A specific API key should be used for data publication via WIS2 so that usage can be tracked.

³² Given that users are encouraged to download Core data from the Global Cache, there will likely be only a few accesses using the WIS2 account's API key. If the usage quota for the WIS2 account is exceeded (i.e., further data access is blocked) then this should encourage users to download via the Global Cache as mandated in the *Manual on WIS* (WMO-No. 1060), Volume II.

³³ Working with presigned URLs on Amazon S3
<https://docs.aws.amazon.com/AmazonS3/latest/userguide/using-presigned-url.html>

³⁴ MQTT broker managed services are available online, often with a free (no cost) starter plan sufficient for infrequent publications of notifications about metadata. These provide a viable alternative to implementing an MQTT broker instance yourself.

1.3.4 Further reading for data publishers

As a Data Publisher planning to operate a WIS2 Node, as a minimum you should read the following sections:

- [Introduction to WIS2](#)
- [WIS2 Architecture](#)
- [Roles in WIS2](#)
- [Components of WIS2](#)
- [Implementation and operation of a WIS2 Node](#)

The following sections are useful for further reading:

- [Information management](#)
- [Security](#)
- [Competencies](#)

Note that sections *4.1. Security* and *5.1. Competencies* reference content originally published for WIS1. These remain largely applicable and will be updated subsequent releases of this Guide.

If you are publishing aviation weather data via WIS2 for onward transmission through International Civil Aviation Organization (ICAO) System Wide Information Management (SWIM), you should also read: 2.8.1.1 Publishing meteorological data through WIS2 into ICAO SWIM section.

Finally, you should also review the specifications in the [Manual on WIS](#) (WMO-No. 1060), Volume II:

- Appendix D: WIS2 Topic Hierarchy
- Appendix E: WIS2 Notification Message
- Appendix F: WMO Core Metadata Profile 2.

PART II

2.1 WIS2 Architecture

WIS2 is a federated system of systems based on Web architecture and open standards, comprising of many WIS2 Nodes for publishing data and Global Services that enable fault tolerant, highly available, low latency data distribution.

National Centres (NC), DCPC, and GISC are all types of WIS Centre.

NCs and DCPCs operate WIS2 Nodes.

GISCs coordinate the operation of WIS within their Area of Responsibility (AoR) and ensure the smooth operation of the WIS2 system.

A WIS Centre may also operate one or more Global Services.

WIS Centres shall comply with the Technical Regulations defined in the *Manual on WIS* (WMO-No. 1060), Volume II.

2.2 Roles in WIS2

When describing the functions of WIS2 there are four roles to consider:

1. Data Publisher;
2. Global Coordinator;
3. Global Service Operator;
4. Data Consumer.

These roles are outlined below.

2.2.1 Data Publisher

- This role is fulfilled by NC and DCPC.
- Data Publishers operate a WIS2 Node to share their data within the WIS2 ecosystem.
- Data Publishers manage, curate, and provide access to one or more "Datasets".
- For each Dataset, a Data Publisher provides:
 - i. "Discovery metadata" to describe the Dataset, provide details on how it can be accessed, and under what conditions;
 - ii. An API or Web service to access (or interact with) the Dataset;
 - iii. Notification messages advertising the availability of new data and metadata.

2.2.2 Global Coordinator

- This role is exclusive to GISCs.
- All GISCs supporting WMO Members in their AoR fulfil their data sharing obligations via WIS2.

2.2.3 Global Service operator

- To ensure highly available global data exchange, a WIS Centre may operate one or more Global Services:
 - i. Global Discovery Catalogue: enables users to search all Datasets provided by Data Publishers and discover where and how to interact with those Datasets (e.g. subscribe to updates, access/download/visualize data, or access more detailed information about the Dataset);
 - ii. Global Broker: provides highly available messaging services where users may subscribe to notifications about all Datasets provided by Data Publishers;
 - iii. Global Cache: provides highly available download service for cached copies of Core data downloaded from Data Publishers' Web-services;

- iv. Global Monitor: gathers and displays system performance, data availability, and other metrics from all WIS2 Nodes and Global Services.

2.2.4 Data Consumer

- This role represents anyone wanting to find, access, and use data from WIS2 – examples include (but are not limited to): NMHS, government agency, research institution, private sector organization, etc.
- Searches or browses the Global Discovery Catalogue (or other search engine) to discover the Dataset(s) that meet their needs (i.e. "Datasets of interest").
- Subscribers via the Global Broker to receive notification messages about the availability of data or metadata associated with Datasets of interest.
- Determines whether the data or metadata referenced in notification messages is required.
- Downloads data from Global Cache or WIS2 Node.

2.3 Specifications of WIS2

Leveraging existing open standards, WIS2 defines the following specifications in support of publish, subscribe, notification, and discovery:

WIS2 Specifications

Specification	Granularity	Primary WIS2 Component(s)
WMO Core Metadata Profile 2 (WCMP2)	Datasets	Global Discovery Catalogue (GDC)
WIS2 Topic Hierarchy (WTH)	Dataset granules	Global Broker, WIS2 Nodes
WIS2 Notification Message	Dataset metadata, Dataset granules	Global Broker, WIS2 Nodes

Please refer to the [Manual on WIS](#) (WMO-No. 1060), Volume II for details.

2.4 Components of WIS2

2.4.1 WIS2 Node

- WIS2 Nodes are central to WIS2. These are operated by NC and DCPC to publish their **Core** and **Recommended** data.
- WIS2 adopts Web technologies and open standards enabling WIS2 Nodes to be implemented using freely available software components and common industry practices.
- WIS2 Nodes publish data as files of a Web server or using an interactive Web service.
- WIS2 Nodes describe the data they publish using discovery metadata. See the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix F: WMO Core Metadata Profile 2.
- WIS2 Nodes generate notification messages advertising the availability of new data. These notification messages are published to a message broker. The WIS2 Topic Hierarchy is used to ensure that all WIS2 Nodes publish to consistent topics. The information in the notification message tells the Data Consumer where to download data from. Notification

messages are also used to advertise the availability of discovery metadata. See the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix D: WIS2 Topic Hierarchy and Appendix E: WIS2 Notification Message.

- WIS2 Nodes may implement controlled access for the data they publish. Global Services will operate with fixed IP addresses, enabling WIS2 Nodes to easily distinguish their requests.

2.4.2 Global Broker

- WIS2 incorporates several Global Brokers, ensuring highly resilient distribution of notification messages across the globe.
- A Global Broker subscribes to the message broker operated by each WIS2 Node and republishes notification messages.
- A Global broker subscribes to notifications from other Global Brokers to ensure it receives a copy of all notification messages.
- A Global Broker republishes notification messages from every WIS2 Node and Global Service.
- A Global Broker operates a highly available, high-performance message broker.
- A Global Broker uses the WIS2 Topic Hierarchy enabling a Data Consumer to easily find topics relevant to their needs.
- Data Consumers should subscribe to notifications from a Global Broker not directly to the message brokers operated by WIS2 Nodes.

2.4.3 Global Cache

- WIS2 incorporates several Global Caches, ensuring highly resilient distribution of data across the globe.
- A Global Cache provides a highly available data server from which a Data Consumer can download Core data, as specified in the WMO Unified Data Policy, through [Resolution 1 \(Cg-Ext \(2021\)\)](#).
- A Global Cache subscribes to notification messages via a Global Broker.
- On receipt of a notification message, the Global Cache downloads from the WIS2 Node a copy data referenced in the notification message, makes this copy available on its data server, and publishes a new notification message advertising availability of this data at the Global Cache.
- A Global Cache will subscribe to notification messages from other Global Caches enabling it to download and republish data it has not acquired directly from WIS2 Nodes. This ensures that each Global Cache holds data from every WIS2 Node.
- A Global Cache shall retain a copy of Core data for a duration compatible with the real-time or near real-time schedule of the data and not less than 24-hours.
- A Global Cache will delete data from the cache once the retention period has expired.
- Data Consumers should download data from a Global Cache when available.

2.4.4 Global Discovery Catalogue (GDC)

- WIS2 includes several GDCs.
- A GDC enables a Data Consumer to search and browse descriptions of data published by each WIS2 Node. The data description (i.e. discovery metadata) provides sufficient information to determine the usefulness of data and how one may access it.
- A GDC subscribes to notification messages via a Global Broker about the availability of new (or updated) discovery metadata. It downloads a copy of the discovery metadata and updates the catalogue.
- A GDC will amend discovery metadata records to add details of where one can subscribe to updates about the Dataset at a Global Broker.
- A Global Discovery Catalogue makes its content available for indexing by search engines.

2.4.5 Global Monitor

- WIS2 includes a Global Monitor service
- The Global Monitor collects metrics from WIS2 components
- The Global Monitor provides a dashboard that supports operational management of the WIS2 system
- The Global Monitor tracks:
 - i. What data is published by WIS2 Nodes;
 - ii. Whether data can be effectively accessed by Data Consumers
 - iii. The performance of components in the WIS2 system.

2.5 Protocols configuration

2.5.1 Publish-Subscribe protocol (MQTT)

- The MQTT protocol³⁵ is to be used for all WIS2 Publish-Subscribe workflow (publication and subscription).
- MQTT v3.1.1 and v5.0 are the chosen protocols for the WIS2 Notification Messages publication and subscription.
 - To connect to Global Brokers, MQTT v5.0 is preferred as it provides additional features such as the ability to use shared subscription.
- The following parameters are to be used for all MQTT client/server connectivity and subscription:
 - Message retention: false
 - Quality of Service (QoS) of 1

³⁵ MQTT Specifications: <https://mqtt.org/mqtt-specification/>

- A maximum of 2000 messages to be held in a queue per client
- In order to permit authentication and authorization for users, WIS2 Node, Global Cache, Global Discovery Catalogue and Global Brokers shall use a user and password based mechanism.
- To improve the overall level of security of WIS2, the secure version of the MQTT protocol is preferred. If used, the certificate must be valid.
- The standard TCP ports to be used are 8883 for Secure MQTT (MQTTS) and 443 for Secure Web Socket (WSS).

2.5.2 Download protocol (HTTP)

- The HTTP protocol (RFC 7231³⁶) is to be used for all WIS2 download workflow.
- To improve the overall level of security of WIS2, the secure version of the HTTP protocol is preferred. If used, the certificate must be valid.
- The standard TCP port to be used is 443 for Secure HTTP (HTTPS).

2.6 Implementation and operation of a WIS2 Node

2.6.1 Practices and procedures

2.6.1.1 Registration and decommissioning of a WIS2 Node

Registration and decommissioning of WIS2 Nodes must be approved by the Permanent Representative with WMO (PR) for the country or territory in which the WIS Centre resides. The WIS National Focal Point can register a WIS2 Node on behalf of the PR for an official NC or DCPC listed in the Manual on WIS (WMO-No. 1060). Where the WIS2 Node is part of a DCPC, the sponsoring WMO Programme or Regional Association shall be consulted.

A WIS2 node can be registered to exchange data concerning a WMO project or campaign, for a limited time. The National Focal Point can register such a project-related WIS2 node in coordination with the Secretariat.

WMO Secretariat will operate a WIS2 register as an authoritative list of WIS2 Nodes and Global Services.

The registration of a WIS2 Node involves the following steps:

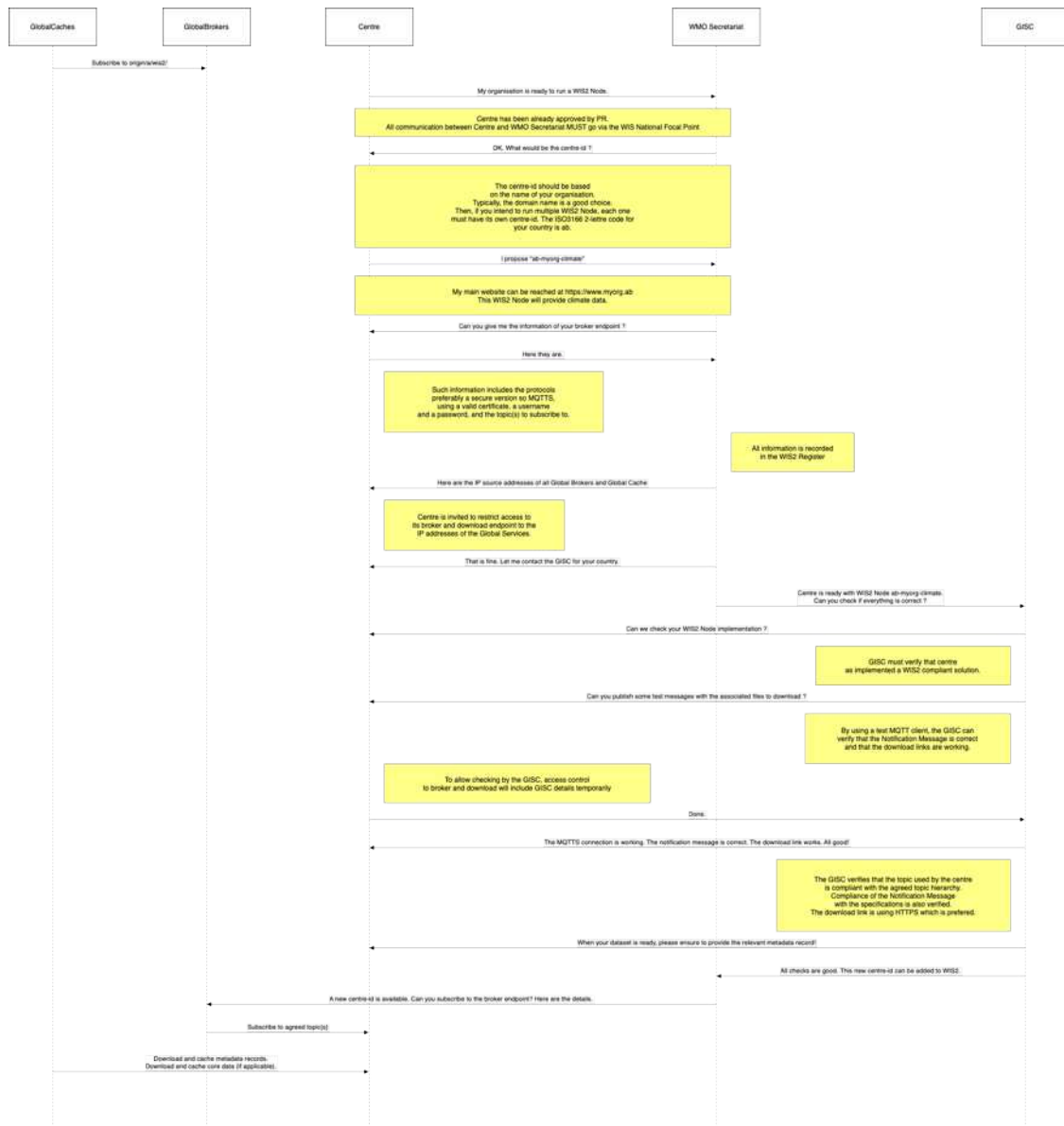
- Request hosting a WIS2 Node: A request for hosting a WIS2 Node shall be put forward by WIS National Focal Point (NFP) of the country of the WIS2 Node host centre, or, in the case of international organizations, by either the Permanent Representative (PR) of the country or territory where the WIS2 Node host centre is located or the president of the relevant organization in case of WMO partner or programme designated as DCPC.
- Assign a centre-id: The centre identifier (**centre-id**) is an acronym as proposed by the Member and endorsed by the WMO Secretariat. It is a single identifier comprised of a Top Level Domain (TLD) and centre-name, and represents the Data Publisher, distributor or issuing centre of a given Dataset or data product/granule (see the *Manual on WIS* (WMO-No. 1060), Volume II, Appendix D: WIS2 Topic Hierarchy). See below for guidance on

³⁶ TFC 7231 – Hypertext Transfer Protocol (HTTP/1.1): <https://datatracker.ietf.org/doc/html/rfc7231>

assigning a centre identifier (2.6.1.2 Guidance on assigning a Centre Identifier for a WIS2 Node).

- Complete the WIS2 Register: The WIS NFP shall complete the WIS2 Register operated by the WMO Secretariat.
- Provide Global Service details: The WMO Secretariat provides connection details for the Global Services (e.g. IP addresses) so that the WIS2 Node can be configured to provide the access.
- WIS2 Node assessment: The principal GISC verifies that the WIS2 Node is compliant with WIS2 requirements. The assessment includes:
 - Verification of the compliance of the topics used by the centre with the WIS2 Topic Hierarchy (WTH) specification;
 - Verification of compliance of notification messages with the WIS2 Notification Message (WNM) specification;
 - Verification that the data server is correctly configured and properly functioning;
 - Verification that the message broker is correctly configured and properly functioning.
- Add new centre to WIS2: Upon completion of this verification, and confirmation that it satisfies all conditions for operating a WIS2 Node, GISC notifies WMO Secretariat and confirms that this WIS2 Node can be added to WIS2
- Communicate details to the Global Services: WMO Secretariat provides the WIS2 Node details to the Global Brokers to subscribe to the WIS2 Node.

A diagram of the process of registering a WIS2 Node is presented below:



Once a WIS2 Node has been registered and connected with the Global Services, it can proceed to register the Datasets it will publish via WIS2. To register a Dataset, the authorized WIS2 Node publishes discovery metadata about the new Dataset. Validation of the discovery metadata is completed by the GDCs, and Global Brokers automatically subscribes to the topics provided in the discovery metadata record. For more information, see [How to provide discovery metadata to WIS2](#).

Once the Dataset has successfully been registered, the WIS2 Node can proceed to exchange data – see 1.3.3 How to provide data to WIS2.

When decommissioning a WIS2 Node operators must ensure that obligations relating to data sharing within WIS continue to be met after the WIS2 Node is decommissioned, for example, by migrating these data sharing obligations to another WIS2 Node. In the case of a DCPC, this may mean the responsibilities are transferred to another Member.

2.6.1.2 Guidance on assigning a Centre Identifier for a WIS2 Node

The centre identifier (**centre-id**) is used in WIS2 to uniquely identify a participating WIS2 Node. The **centre-id** must conform to the specification given in the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix D: WIS2 Topic Hierarchy, section 7.1.6 Centre identification.

The **centre-id** comprises two dash-separated tokens.

Token 1 is a *TLD* defined by IANA³⁷.

This is usually a simple choice for a member. However, overseas territories require some thought. The recommended approach depends on the governance of the overseas territory. Take some French examples. Réunion is a French Department – it is considered part of France; it uses the Euro. Here, we would use the “fr” TLD. New Caledonia is a French overseas territory with top-level-domain of “nc”. It has separate, devolved governance. The recommendation is to use “nc”. All that said, it is a national decision which TLD to use.

Token 2 is a descriptive name for the centre, and this may contain dashes (but not other special characters).

The descriptive name should be something recognizable – not only by our community, but by other users too. Basing things on the Web domain name is likely to ensure that centre identifiers remain unique within a particular country/territory. A UK example this time: the UK’s National Meteorological Service is the Met Office (<http://www.metoffice.gov.uk>), so “metoffice” is better than “ukmo”³⁸. Using the 4-letter GTS centre identifiers (**CCCC**) is not recommended because people unfamiliar with the GTS do not understand them.

The **centre-id** specification says that larger organizations operating multiple centres may wish to register separate centre-ids for each centre. This is good practice. Keeping with the UK example, Met Office operates a National Meteorological Centre (NMC), 9 DCPCs (e.g. a Volcanic Ash Advisory Centre) and a WIS2 Global Service, so it is important to split them out. For example:

- **Uk-metoffice-nmc**
- **Uk-metoffice-vaac**
- **Uk-metoffice-global-cache**

Using a system name in the centre-id is not a good idea because these may change over time. Functional designations are long-term durable. Appending **-test** may be used to designate test WIS Nodes.

Appending “-test” may be used to designate test WIS Nodes.

2.6.1.3 Authentication, authorization, and access control for a WIS2 Node

When configuring your WIS2 Node you need to consider how it will be accessed by Global Services and Data Consumers.

Global Brokers must authenticate when they connect to the MQTT message broker in your WIS2 Node. Username and password credentials are used³⁹. When registering your WIS2 Node with the WMO Secretariat, you will need to provide these credentials. The WMO Secretariat will share these credentials with the Global Service operators and store them in the WIS register. You should not consider these credentials as confidential or secret.

³⁷ IANA Top Level Domains <https://data.iana.org/TLD>

³⁸ The “.gov” part of the domain name is superfluous for the purposes of WIS2. There is nothing preventing its use, but it does not add any value.

³⁹ The default connection credentials for a WIS2 Node message broker are username **everyone** and password **everyone**. WIS2 Node operators should choose credentials that meet their local policies (e.g. password complexity).

Given that Global Brokers will republish notification messages provided by your WIS2 Node, you may decide to restrict access to the MQTT message broker. Global Brokers operate using a fixed IP address which allows you to permit them access using IP filtering⁴⁰. You must ensure that your MQTT message broker is accessible for more than one Global Broker to provide resilient transmission of notification messages to WIS2.

If your WIS2 Node is only publishing Core data⁴¹, you may also restrict access to your data server – instead, relying on the Global Caches to distribute your data. Similarly, Global Caches also operate on fixed IP addresses allowing connections from them to be easily identified. Again, you must ensure that access is given to more than one Global Broker to ensure resilience.

During registration, the WMO Secretariat will provide host names and IP addresses of the Global Services to enable configuration of access control.

Access controls may be implemented for Recommended data. You should use only the "security schemes" for authentication and authorization specified in Open API⁴².

2.6.2 Performance management

2.6.2.1 Service levels and performance indicators

A WIS2 Node must be able to:

- Publish Datasets and compliant metadata and discovery metadata
 - Publish metadata to the Global Data Catalogue
 - Publish Core data to the Global Cache
 - Publish data for consumer access
 - Publish data embedded in a message (i.e. CAP warnings)
 - Receive metadata publication errors from the Global Data Catalogue
 - Provide metadata with topics to Global Brokers.

2.6.2.2 System performance metrics

If contacted by the Global Monitor via GISC for a performance issue, the WIS2 Node should provide metrics to the GISC and Global Monitor when service is restored to indicate resolution of the issue.

⁴⁰ In WIS2 we use IP addresses to determine the origin of connections and therefore confer trust to remote systems. It is well-documented that IP addresses can be hi-jacked and that there are alternative, more sophisticated, mechanisms available for reliably determining the origin of connections requests, such as Public Key Infrastructure (PKI). However, the complexities of such implementation would introduce a barrier to Member's participation in WIS2. IP addresses are considered to provide an adequate level of trust for the purposes of WIS2: distributing publicly accessible data and messages.

⁴¹ In some cases, WIS2 Nodes will need to serve Core data directly (see [Considerations when providing Core data in WIS2](#)). In these situations, the WIS2 Node data server must remain publicly accessible.

⁴² Open API Security Scheme Object: <https://spec.openapis.org/oas/v3.1.0#security-scheme-object>

2.6.3 WIS2 Node reference implementation: WIS2 in a box

To provide a WIS2 Node, Members may use whichever software components they consider most appropriate to comply with WIS2 Technical Regulations.

To assist Members, participate in WIS2, a free and open-source Reference Implementation is available for use. WIS2 in a box (wis2box) implements the requirements of a WIS2 Node in as well-as additional enhancements. wis2box builds on mature and robust free and open-source software components that are widely adopted for operational use.

wis2box provides functionality required for both Data Publisher and Data Consumer roles. It provides the following technical functions:

- Configuration, generation, and publication of data (real-time or archive) and metadata to WIS2, compliant to WIS2 Node requirements
- MQTT Message Broker and notification message publication (Subscribe)
- HTTP object storage and raw data access (Download)
- Station metadata curation / editing tools (user interface)
- Discovery metadata curation / editing tools (user interface)
- Data entry tools (user interfaces)
- OGC API server, providing dynamic APIs for discovery, access, visualization, and processing functionality (APIs)
- Extensible data "pipelines", allowing for transformation, processing and publishing of additional data types
- Provision of system performance and data availability metrics
- Access control for recommended data publication, as required
- Subscription to notifications and download of WIS data from Global Services
- Modular design, allowing for extending to meet additional requirements or integrate with existing data management systems.

Project documentation can be found at <https://docs.wis2box.wis.wmo.int>

Wis2box is managed as a free and open-source project. Source code, issue tracking and discussions are hosted in the open on GitHub: <https://docs.wis2box.wis.wmo.int>.

2.7 Implementation and operation of a Global Service

2.7.1 Procedure for registration of a new Global Service

Successful operations of WIS will depend on having a set of Global Services running well-managed IT environments with a very high level of reliability so that all WIS Users and WIS2 Nodes will be able to access and provide data they need for their duties.

Depending on the nature of the Global Service, the following is the minimum capability of Global Service operation, so that collectively, the level of service is 100% (or very close):

- Three (3) Global Brokers: Each Global Broker connected to at least two (2) other Global Brokers
- Three (3) Global Caches: Each Global Cache connected to at least two (2) Global Broker and should be able to download the data from all WIS2 Nodes providing Core data
- Two (2) GDCs: Each GDC connected to at least one (1) Global Broker
- Two (2) Global Monitors: Each Global Monitor should scrape the metrics from all other Global Services.

In addition to the above, WIS architecture can accommodate adding (or removing) Global Services. Candidate WIS Centres should inform their WIS Focal Point and contact the WMO Secretariat to discuss their offer to provide a Global Service.

Running a Global Service is a significant commitment for a WIS Centre. To maintain a very high level of service of WIS, each Global Service will have a key role to play.

On receipt of an offer from a member to operate a Global Service, WMO Secretariat will suggest which Global Service the Member may provide to improve WIS2. This suggestion will be based on the current situation of WIS2 (e.g. the number of existing Global Brokers, whether an additional Global Cache is needed, etc.).

The *Manual on WIS* (WMO-No. 1060), Volume II, the Guide and other material available will help WIS Centres in deciding the best way forward.

When decided, the WIS Focal Point will inform WMO Secretariat of its preference. Depending on the type of Global Service, WMO Secretariat will provide a checklist to the WIS Centre so that the future Global Service can be included in WIS Operations.

A WIS Centre must commit to running the Global Service for a minimum of four (4) years.

WMO Secretariat and other Global Services will make the required changes to include the new Global Service in WIS Operations.

2.7.2 Performance management and monitoring of a Global Service

2.7.2.1 Monitoring and metrics for WIS2 operations

The availability of data and performance of system components within WIS2 are actively monitored by GISCs and the Global Monitor service to ensure proactive response to incidents and effective capacity planning for future operations.

WIS2 requires that metrics are provided using Open Metrics – the de-facto standard⁴³ for transmitting cloud-native metrics at scale. Widely adopted, many commercial and open-source software components already come preconfigured to provide performance metrics using the Open Metrics standard. Tools such as Prometheus and Grafana provide aggregation and visualization of metrics provided in this form, making it simple to generate performance insights. The Open Metrics standard can be found at [www.openmetrics.io](https://openmetrics.io)⁴⁴.

The WIS2 Global Services, namely the Global Broker, Global Cache, and Global Discovery Catalogue expose monitoring metrics on their respective service to the Global Monitor.

⁴³ Open Metrics is proposed as a draft standard within IETF.

⁴⁴ <https://openmetrics.io>

There is no requirement on WIS2 Nodes to provide monitoring metrics. However, their WIS2 interfaces may be queried remotely by Global Services, which in turn can provide metrics on the availability of WIS2 Nodes.

Metrics for the WIS2 monitoring should follow the naming convention:

wmo_<program>_<name>

Where program is the name of the responsible WMO Program and name is the name of the metric. Examples for WIS2 metrics can look like

wmo_wis2_gc_downloaded_total

wmo_wis2_gb_messages_invalid_total

The full set of the WIS2 monitoring metrics is given in WMO: WIS2 Metric Hierarchy⁴⁵

2.7.2.2 Service levels, performance indicators, and fair-usage policies

- Each WIS Centre operating a WIS2 Node will be responsible in achieving the highest possible level of service based on their resources and capabilities.
- All Global Services, and in particular Global Brokers and Global Caches, are collectively responsible in making the WIS a reliable and efficient mean to exchange data required for the operations of all WIS Centres. The agreed architecture provides a redundant solution where the failure of one component will not impact the overall level of service of WIS.
- Each Global Service should aim at achieving at least 99.5% availability of the service they propose. This is not a contractual target. It should be considered by the entity providing the Global Service as a guideline when designing and operating the Global Service.
- A Global Broker:
 - Should support a minimum of 200 WIS2 Nodes or Global Services
 - Should support a minimum of 1000 subscribers
 - Should support processing of a minimum of 10000 messages per second.
- A Global Cache:
 - Should support a minimum of 100 GB of data in the cache
 - Should support a minimum of 1000 simultaneous downloads
 - Could limit the number of simultaneous connections from a user (known by its originating source IP) to 5
 - Could limit the bandwidth usage of the service to 1 Gb/s.
- A Global Monitor:
 - Should support a minimum of 50 metrics providers
 - Should support 200 simultaneous access to the dashboard

⁴⁵ <https://github.com/wmo-im/wis2-metric-hierarchy>

- Could limit the bandwidth usage of the service to 100 Mb/s.
- A Global Discovery Catalogue:
 - Should support a minimum of 20000 metadata records
 - Should support a minimum of 50 requests per second to the API endpoint.

2.7.2.3 Metrics for Global Services

In the following sections and for each Global Service, a set of metrics is defined. Each Global Service will provide those metrics. They will then be ingested by the Global Monitor.

2.7.3 Global Broker

2.7.3.1 Technical considerations

- As detailed above, there will be at least three (3) instances of Global Broker to ensure highly available, low latency global provision of messages within WIS.
- A Global Broker instance subscribes to messages from WIS2 Nodes and other Global Services. The Global Broker should aim at subscribing to all WIS Centres. If this is not possible, for whatever reason, the Global Broker should inform WMO Secretariat so that situation is documented.
- Every WIS2 Node or Global Service must have subscriptions from at least two Global Brokers.
- For full global coverage, a Global Broker instance will subscribe to messages from at least two (2) other Global Brokers.
- When subscribing to messages from WIS2 Node and other Global Services, a Global Broker must authenticate using the valid credentials managed by the WIS Centre and available at WMO Secretariat.
- A Global Broker is built around two software components:
 - An off the shelf broker implementing both MQTT 3.1.1 and MQTT 5.0 in a highly available setup, typically in a cluster mode. Tools such as EMQX, HiveMQ, VerneMQ, RabbitMQ (in its latest versions) are compliant with these requirements. It must be noted that the open-source version of Mosquitto cannot be clustered and therefore should not be used as part of a Global Broker.
 - Additional features including anti-loop detection, notification message format compliance, validation of the published topic, and provision of metrics are required.
- When receiving a message from a WIS Centre or Global Service broker, the metric **wmo_wis2_gb_messages_received_total** will be increased by 1.
- A Global Broker will check if the topic on which the message is received is valid (in particular, a discovery metadata record must exist with a corresponding topic in order that data can be made available using this topic). If the topic is invalid, the Global Broker will discard non-compliant messages and will raise an alert. The metric **wmo_wis2_gb_messages_no_metadata_total** will be increased by one. Global Broker should not request GDC for each notification message but should keep a cache of all valid topics for every **centre-id**.

- During the pre-operational phase (2024), Global Broker will not discard the message but will send a message on the **monitor** topic hierarchy to inform the originating centre and its GISC.
- A Global Broker will validate notification messages against the standard format (see Notification message format and structure), discarding non-compliant messages and raising an alert. The metric **wmo_wis2_gb_messages_invalid_total** will be increased by 1.
- A Global Broker instance will republish a message only once. Using the message id as defined in WIS Notification Message, the Global Broker will record id of messages already published and will discard subsequent identical (with the same message id) messages. This is the anti-loop feature of the Global Broker.
- When publishing a message to the local broker, the metric **wmo_wis2_gb_messages_published_total** will be increased by 1.
- All above defined metrics will be made available on HTTPS endpoints that the Global Monitor will ingest from regularly.
- As a convention Global Broker centre-id will be **tld-{centre-name}-global-broker**.
- A Global Broker should operate with a fixed IP address so that WIS2 Nodes can permit access to download resources based on IP address filtering. A Global Broker should also operate with a public resolvable Domain Name Server (DNS) name pointing to that IP address. The WMO Secretariat must be informed of the IP address and/or host name, and any subsequent changes.

2.7.4 Global Cache

In WIS2 Global Caches provide access to WMO Core Data for Data Consumers. This allows for data providers to restrict access to their systems to Global Services and it reduces the need for them to provide high bandwidth and low latency access to their data. Global Caches work transparent for end users in that they resend notification messages from data providers which are updated to point to the Global Cache data store for data, they copied from the original source. Additionally, Global Caches also resend notification messages from data providers for Core data, that is not stored on the Global Cache, for instance if the originator indicates that a certain data set should not be cached in the notification message. In the latter case, the notification messages that a Global Cache resends are unchanged and point to the original source. Data Consumers should subscribe to the notification messages from Global Caches instead of the notification messages from the data providers for WMO Core Data. When Data Consumers receive a notification message, they should follow the URLs from that messages which either point to a Global Cache holding a copy of the data, or – in case of uncached content – point to the original source.

2.7.4.1 Technical considerations

- A Global Cache is built around three software components:
 - A highly available data server allowing Data Consumers to download cache resources with high bandwidth and low latency
 - A message broker implementing both MQTTv3.1.1 and MQTTv5 for publishing notification messages about resources that are available from the Global Cache

- A Cache management implementing the features needed to connect with the WIS ecosystem, receive data from WIS2 Nodes and other Global Caches, store the data to the data server and manage the content of the cache (i.e. expiration of data, deduplication, etc).
- The Global Cache will aim at containing copies of real-time and near real-time data designated as "Core" within the WMO Unified Data Policy, [Resolution 1 \(Cg-Ext\(2021\)\)](#).
- A Global Cache instance will host data objects copied from NC/DCPCs.
- A Global Cache instance will publish notification messages advertising availability of the data objects it holds. The notification messages will follow the standard structure (see [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix E: WIS2 Notification Message).
- A Global Cache instance will use the standard topic structure in their local message brokers (see [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix D: WIS2 Topic Hierarchy).
- A Global Cache instance will publish on topic **cache/a/wis2/...**
- There will be multiple Global Cache instances to ensure highly available, low latency global provision of real-time and near real-time "Core" data within WIS2.
- There will be multiple Global Cache instances may attempt to download cacheable data objects from all originating centres with "cacheable" content. A Global Cache instance will also download data objects from other Global Cache instances. This ensures the instance has full global coverage, mitigating where direct download from an originating centre is not possible.
- A Global Cache instance will operate independently of other Global Cache instances. Each Global Cache instance will hold a full copy of the cache – albeit that there may be small differences between Global Cache instances as "data availability" notification messages propagate through WIS to each Global Cache in turn. There is no formal "synchronization" between Global Cache instances.
- A Global Cache will temporarily cache all resources published on the **metadata** topic. A GDC will subscribe to notifications about publication of new or updated metadata, download the metadata record from the Global Cache and insert it into the catalogue. A GDC will also publish a metadata record archive each day containing the complete content of the catalogue and advertise its availability with a notification message. This resource will also be cached by a Global Cache.
- A Global Cache is designed to support real-time distribution of content. Data Consumers access data objects from a Global Cache instance by resolving the URL in a "data availability" notification message and downloading the file to which the URL points. Apart from the URL it is transparent to the Data Consumers from which Global Cache they download the data. There is no need to download the same data object from multiple Global Caches. The data id contained within the notification messages is used by Data Consumers and Global Services to detect such duplicates.
- There is no requirement for a Global Cache to provide a "browse-able" interface to the files in its repository allowing Data Consumers to discover what content is available. However, a Global Cache may choose to provide such a capability (e.g. implemented as a "Web Accessible Folder", or WAF) along with adequate documentation for Data Consumers to understand how the capability works.

- The default behaviour for a Global Cache is to cache all data published under the **origin/a/wis2/data/+core** topic. A Data Publisher may indicate that data should not be cached by adding the **"cache": false** assertion in the WIS Notification Message.
- A Global Cache may decide not to cache data. For example, if the data is considered too large, or a WIS2 Node publishes an excessive number of small files. Where a Global Cache decides not to cache data it should behave as though the **cache** property is set to false and send a message on the **monitor** topic hierarchy to inform the originating centre and its GISC. The Global Cache operator should work with the originating WIS2 Node and their GISC to remedy the issue.
- If Core data is not cached on a Global Cache (that is, if the data is flagged as **"cache": false** or if the Global Cache decides not to cache this data), the Global Cache shall nevertheless republish the WIS2 Notification Message to the **cache/a/wis2/...** topic. In this case the message id will be changed, and the rest of the message will not be modified.
- A Global Cache should operate with a fixed IP address so that WIS2 Nodes can permit access to download resources based on IP address filtering. A Global Cache should also operate with a public resolvable DNS name pointing to that IP address. The WMO Secretariat must be informed of the IP address and/or host name, and any subsequent changes.
- A Global Cache should validate the integrity of the resources it caches and only accept data which matches the integrity value from the WIS Notification Message. If the WIS Notification Message does not contain an integrity value, a Global Cache should accept the data as valid. In this case a Global Cache may add an integrity value to the message it republishes.
- As a convention Global Cache centre-id will be **tld-{centre-name}-global-cache**.

2.7.4.2 Practices and procedures

- A Global Cache shall subscribe to the topics **origin/a/wis2/#**, **cache/a/wis2/#**.
- A Global Cache shall ignore all messages received on the topics **origin/a/wis2/+data/recommended/#** and **cache/a/wis2/+data/recommended/#** ⁴⁶.
- A Global Cache shall retain the data and metadata they receive for a minimum period of 24 hours. Requirements relating varying retention times for different types of data may be added later.
- For messages received on topic **origin/a/+data/core/#** or **cache/a/+data/core/#**, a Global Cache shall:
 - If the message contains the property **"properties.cache": false**
 - Republish the message at topic **cache/a/wis2/...** matching **+a/wis2/...** where the original message has been received after having updated the id of the message.
 - Else

⁴⁶ It is also technically possible to filter recommended data by using a wildcard subscription such as **origin/a/wis2/+data/core/#**. However, avoiding wildcard subscription is generally considered good practice as it limits the burden of the broker operated by Global Brokers.

- Maintain a list of `data_ids` already downloaded.
- Verify if the message points to new or updated data by comparing the `pubtime` value of the notification message with the list of `data_ids`.
- If the message is new or updated:
 - Download only new or updated data from the **href** or extract the data from the message content.
 - If the message contains an integrity value for the data, verify the integrity of the data.
 - If data is downloaded successfully, move the data to the HTTP endpoint of the Global Cache.
 - Wait until the data becomes available at the endpoint.
 - Modify the message identifier and the canonical link's **href** of the received message. Leave all other fields untouched.
 - Republish the modified message to topic **cache/a/wis2/...** matching the **+ /a/wis2/...** where the original message has been received.
 - The metric **wmo_wis2_gc_downloaded_total** will be increased by one. The metric **wmo_wis2_gc_dataserver_last_download_timestamp_seconds** will be updated with the timestamp (in seconds) of the last successful download from the WIS2 Node or Global Cache.
- Else
 - Drop the messages for data already present on the Cache.
- If the Global Cache is not able to download the data, the metric **wmo_wis2_gc_downloaded_error_total** will be increased by 1.
- A Global Cache shall provide the metric defined in this Guide at an `http(s)` endpoint.
- A Global Cache should make sure that data is downloaded in parallel, and downloads are not blocking each other.
- The metric **wmo_wis2_gc_dataserver_status_flag** will reflect the status of the connection to the download endpoint of the Centre. Its values will be one when the endpoint is up and zero otherwise.

2.7.5 Global Discovery Catalogue (GDC)

2.7.5.1 Technical considerations

- The GDC provides Data Consumers with a mechanism to discover and search for Datasets of interest, as well as how to interact with and find out more information about those Datasets.

- The GDC implements the OGC API – Records – Part 1: Core standard⁴⁷, adhering to the following conformance classes and their dependencies:
 - Searchable Catalogue (Deployment)
 - Searchable Catalogue – Sorting (Deployment)
 - Searchable Catalogue – Filtering (Deployment)
 - JSON (Building Block)
 - HTML (Building Block)
- The GDC will make discovery metadata available via the collection identifier of **wis2-discovery-metadata**.
- The GDC advertises the availability of Datasets and how to access them or subscribe to updates.
- The GDC does not advertise or list the availability of individual Data Objects that comprise a Dataset (i.e. data files).
- A single GDC instance is sufficient for WIS2.
- Multiple GDC instances may be deployed for resilience.
- GDC instances operate independently of each other; each GDC instance will hold all discovery metadata records. GDCs do not need to synchronize between themselves.
- A GDC is populated with discovery metadata records from a Global Cache instance, receiving messages about the availability of discovery metadata records via a Global Broker.
- A GDC should connect and subscribe to more than one Global Broker instance to ensure that no messages are lost in the event of a Global Broker failure. A GDC instance will discard duplicate messages as needed.
- A GDC will validate that a discovery metadata record identifier's **centre-id** token (see [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix F: WMO Core Metadata Profile 2) matches against the **centre-id** level of the topic from which it was published (see [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix D: WIS2 Topic Hierarchy), to ensure that discovery metadata is published by the authoritative organization.
- A Global Discovery Catalogue will validate discovery metadata records against the WMO Core Metadata Profile 2 (WCMP2). Valid WCMP2 records will be ingested into the catalogue. Invalid or malformed records will be discarded and reported to the Global Monitor against the centre identifier associated with the discovery metadata record.
- A Global Discovery Catalogue will only update discovery metadata records to replace links for Dataset subscription and notification (origin) with their equivalent links for subscription at Global Broker instances (cache).
- A Global Discovery Catalogue will periodically assess discovery metadata provided by NCs and DCPCs against a set of key performance indicators (KPIs) in support of continuous improvement. Suggestions for improvement will be reported to the Global Monitor against the centre identifier associated with the discovery metadata record.

⁴⁷ OGC API Records – Part 1 <https://docs.ogc.org/DRAFTS/20-004.html>

- A GDC will remove discovery metadata that is marked for deletion as specified in the data notification message.
- A GDC should apply faceting capability as specified in the cataloguing considerations of the WCMP2 specification, as defined in OGC API – Records.
- A GDC will provide human-readable Web pages with embedded markup using the schema.org vocabulary, thereby enabling search engines to crawl and index the content of the GDC. Consequently, Data Consumers should also be able to discover WIS content via third party search engines.
- A GDC will generate and store a zip file of all WCMP2 records once a day, that will be made be accessible via HTTP.
- A GDC will publish a WIS2 Notification Message of its zip file of all WCMP2 records on its centre-id's metadata topic (i.e. **origin/a/wis2/centre-id/metadata**, where **centre-id** is the centre identifier of the GDC).
- A GDC may initialize itself (cold start) from a zip file of all WCMP2 records published.
- As a convention GDC centre-id will be **tld-{centre-name}-global-discovery-catalogue**.

2.7.5.2 Global Discovery Catalogue (GDC) reference implementation: wis2-gdc

To provide a GDC, Members may use whichever software components they consider most appropriate to comply with WIS2 Technical Regulations.

To assist Members participation in WIS2, a free and open-source GDC Reference Implementation is made available for download and use. wis2-gdc builds on mature and robust free and open-source software components that are widely adopted for operational use.

Wis2-gdc provides functionality required GDC, providing the following technical functions:

- Discovery metadata subscription and publication from the Global Broker
- Discovery metadata download the Global Cache
- Discovery metadata validation, ingest and publication
- WCMP2 compliance
- Quality assessment (KPIs)
- OGC API – Records – Part 1: Core compliance
- Metrics reporting
- Implementation of metrics

Wis2-gdc is managed as a free and open-source project. Source code, issue tracking and discussions are hosted in the open on GitHub: <https://github.com/wmo-im/wis2-gdc>.

2.7.6 Global Monitor

2.7.6.1 Technical Considerations

- WIS standardizes how system performance and data availability metrics are published from WIS2 Nodes and Global Services.
- For each type of Global Service, a set of standard metrics have been defined. Global Services will implement those metrics and provide an endpoint for those metrics to be scraped by the Global Monitor.
- The Global Monitor will collect metrics as defined in the Open Metrics standard.
- The Global Monitor will monitor the 'health' (i.e. performance) of components at NC/DCPC as well-as Global Service instances.
- The Global Monitor will provide a Web-based 'dashboard' that displays the WIS2 system performance and data availability.
- As a convention Global Monitor centre-id will be **tld-{centre-name}-global-monitor**.

The main task of the Global Monitor is to regularly query the provided metrics from the relevant WIS2 entities, aggregate and process the data and then provide the results to the end user in a suitable presentation.

2.8 Operations

2.8.1 Interoperability with external systems

The WIS2 principles enable lowering the barrier to weather/climate/water data for WMO Members. Lowering the barrier is driven by **international standards** for data discovery, access, and visualization. In addition to Member benefits, a by-product of utilizing standards is being able to provide the same data and access mechanisms to external systems at no extra cost of implementation.

WIS2 standards are based on industry standards (OGC, W3C, IETF) and allow for **broad** interoperability. This means that non-traditional users can also use data from WIS2 data in the same manner, without the requirement for specialized software, tools, or applications.

2.8.1.1 Publishing meteorological data through WIS2 into ICAO SWIM

Meteorological data is an essential input for public weather services and aviation services alike. WIS2 provides the mechanism for data exchange in WMO, while SWIM (System Wide Information Management) is the ICAO initiative to harmonize the provision of aeronautical, meteorological and flight information to support air traffic management (ATM).

Both WIS2 and SWIM support the similar outcomes relating to data exchange. However, there are differences in both approach and implementation.

Specifications for WIS2 are defined in the [Manual on WIS](#) (WMO-No. 1060), Volume II, and further elaborated in this Guide. Specifications for SWIM will be defined in the Procedures for Air Navigation Services – Information Management (PANS-IM) (ICAO Doc. 10199)⁴⁸.

⁴⁸ The PANS-IM is expected to be available on ICAO NET by July 2024 and become applicable in November 2024. Information provided in herein is based on best understanding of draft proposals from ICAO.

During the WIS2 transition phase (2025–2030), meteorological data published via WIS2 will automatically be published to the GTS via the WIS2 WIS2-to-GTS Gateways.

WIS2	SWIM
Earth system scope: weather, climate, hydrology, atmospheric composition, cryosphere, ocean, and space weather data	ATM scope: aeronautical, meteorological and flight information
Data centric – a consumer discovers data and then determines the services through which that data may be accessed	Service centric – a consumer discovers a service (or service provider) and determines what resources (i.e. information) is available therein
Technical protocols: MQTT, HTTP	Technical protocols: AMQP ⁴⁹

An organization (e.g. the National Meteorological Service) that is responsible for providing meteorological data to WIS2 may be designated by the ICAO Contracting State as a responsible entity to provide aeronautical meteorological information into SWIM. Where requirements dictate, the organization may provide regional capability on behalf of a group of countries or territories.

This section of the Guide outlines how such an organization may efficiently fulfil the requirements in providing required data/information to the two systems. It proposes an interoperability approach between WIS2 and SWIM where meteorological data published via WIS2 can be automatically propagated to SWIM.

This Guide covers only how data from WIS2 can be published into SWIM. Consumption of information from SWIM services is not in scope.

This Guide also does not cover implementation details of the SWIM service – including, but not limited to:

- Mechanisms used by SWIM to discover service providers and services
- Specification of the SWIM data message
- AMQP message broker configuration
- Operation, logging, and monitoring
- Cybersecurity considerations for provision of SWIM services.

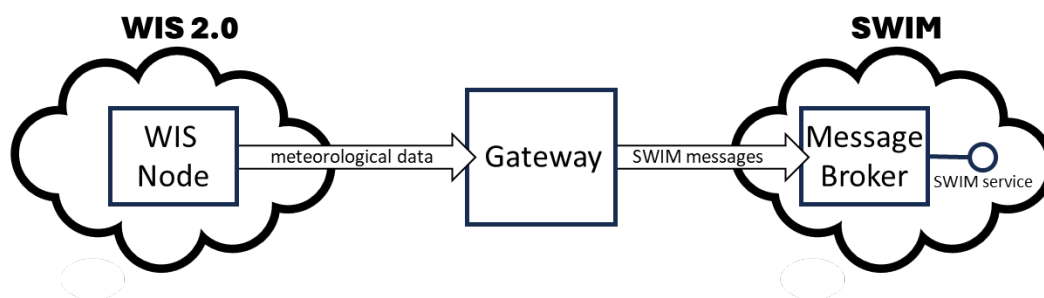
This Guide will be updated as more information is made available from ICAO and/or recommended practices are updated.

Finally, it should be noted that the provision of aeronautical meteorological information and its exchange via the ICAO Aeronautical Fixed Service (AFS) is also out of scope as they are solely defined under the ICAO regulatory framework.

2.8.1.1.1 WIS2 to SWIM Gateway

The WIS2 to SWIM interoperability approach employs a Gateway component (as per the figure below):

⁴⁹ AMQP 1.0 is one of the protocols proposed in the draft PANS-IM



Schematic of an interoperability approach

The Gateway can operate as an "adapter" between WIS2 and SWIM by pulling the requisite meteorological data from WIS2 and re-publishing it to SWIM.

2.8.1.1.2 Data types and format

Specifications for aeronautical meteorological information are provided in ICAO Annex 3 and other relevant guidance materials. IWXXM format (FM 205)⁵⁰ is to be used for encoding aeronautical meteorological information in SWIM.

2.8.1.1.3 Publishing meteorological data via WIS2

For meteorological data to be published from WIS2 to SWIM, the organization responsible for this provision will need to operate a WIS2 Node and comply with the pertinent Technical Regulations as specified in the [Manual on WIS](#) (WMO-No. 1060), Volume II. Onward distribution of the data by the Message Broker over SWIM can be handled by the respective Information Service Provider in accordance with ICAO Standards and Recommended Practices (SARPs).

The responsible organization should consider whether this data should be published via an existing WIS2 Node, or whether a separate WIS2 Node should be established. For example, the data may be provided by a separate operational unit, or there may be a requirement to easily distinguish between data for SWIM and any other meteorological data.

Where a new WIS2 Node is needed, the responsible organization must establish a new WIS2 Node and register it with WMO Secretariat. For more information, see [Implementation and operation of a WIS2 Node](#).

Datasets are a central concept in WIS2. Where meteorological data is published via WIS2, it shall be packaged into "Datasets". The data should be grouped at the country / territory level, i.e. Datasets should be published for a given country / territory, one for each datatype (e.g. aerodrome observation, aerodrome forecast and quantitative volcanic ash concentration information).

For the purposes of publishing through WIS2, Datasets containing aeronautical meteorological information should be considered as "**Recommended Data**", as described in the WMO Unified Data Policy, [Resolution 1 \(Cg-Ext\(2021\)\)](#). The Recommended Data category of the policy is intended to cover data that should be exchanged by Members to support Earth system monitoring and prediction efforts.

Recommended Data:

- May be subject to conditions on use and reuse

⁵⁰ IWXXM (FM205) is defined in the *Manual on Codes* (WMO-No. 306), Volume I.3 – International Codes

- May have access controls⁵¹⁵² applied at the WIS2 Node
- Are **not** cached within WIS2 by the Global Caches⁵³

The WMO Unified Data Policy requires transparency on the conditions of use for Recommended Data. Conditions regarding the use of aeronautical meteorological information are specified in ICAO Annex 3 and, optionally, by the ICAO Contracting State. Such conditions of use should be explicitly stated in the discovery metadata for each Dataset as describe below.

- The attribute **wmo: dataPolicy** should be set to **recommended**
- Information about conditions of use should be specified using a **rights** property (see example below) and/or a **link** object with relation **license**
- Information about access control should be specified using a **security** object in the **link** object describing the data access details

Example expression of conditions relating to the use of aeronautical meteorological information:

```
"properties": {
...
  "rights": "This information is freely disseminated for the purposes of safety of
international air navigation. ICAO Annex 3"
...
}
```

For more information on the WMO Core Metadata Profile version 2, see the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix F.

On receipt of new data, the WIS2 Node will:

1. Publish the data as a resource via a Web server (or Web service);
2. Publish a WIS2 Notification Message to a local message broker that advertises the availability of the data resource.

Note that, in contrast to the GTS, WIS2 publishes data resources individually, each with an associated notification message. WIS2 does not group data resources into bulletins.

The data resource is identified using a URL. The notification message refers to the data resource using this URL⁵⁴.

For more details on the WIS2 Notification Message, see the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix E: WIS2 Notification Message.

The notification message must be published to the proper topic on the message broker. WIS2 defines a standard topic hierarchy to ensure that data is published consistently by all WIS2 Nodes. Notification messages for aviation data should be published on a specific topic allowing

⁵¹ WIS2 follows the recommendations from Open API regarding choice of security schemes for authenticated access – a choice of HTTP authentication, API keys, OAuth2 or OpenID Connect Discovery. For more information see Open API Security Scheme Object: <https://spec.openapis.org/oas/v3.1.0#security-scheme-object>

⁵² WIS2 does not provide any guidance on use of Public Key Infrastructure (PKI).

⁵³ Global Caches enable highly available, low latency distribution of Core data. Given that Core data is provided on a free and unrestricted basis, Global Caches **do not** implement any data access control.

⁵⁴ Where the data resource does not exceed 4 Kb, it may additionally be embedded in the notification message.

a Data Consumer, such as the Gateway, to subscribe only to aviation-specific notifications. See the example below:

Example Topic used to publish notifications about Quantitative Volcanic Ash Concentration Information.

```
origin/a/wis2/{centre-id}/data/recommended/weather/aviation/qvac
```

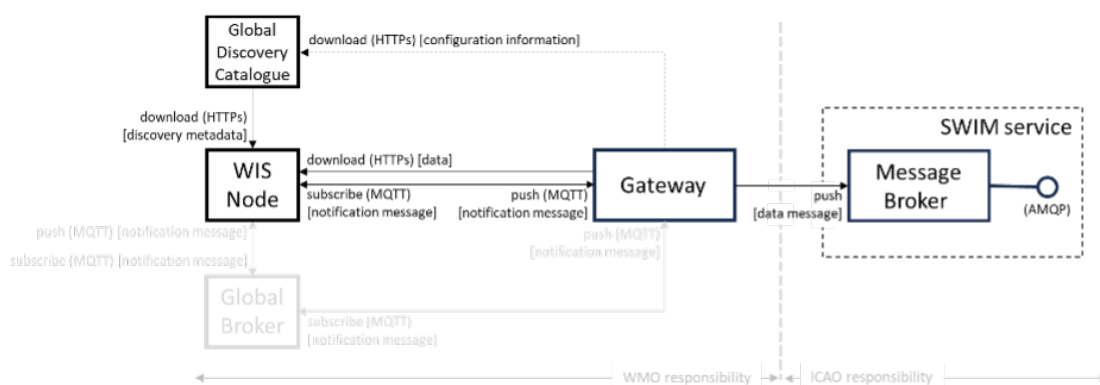
For more details of the WIS Topic Hierarchy, see the [Manual on WIS](#) (WMO-No. 1060), Volume II, Appendix D: WIS2 Topic Hierarchy.

WIS Global Brokers subscribe to the local message brokers of WIS2 Nodes and republish notification messages for global distribution.

As a minimum, the WIS2 Node should retain the aviation data for a duration that meets the needs of the Gateway. The retention period of at least 24 hours is recommended.

2.8.1.1.4 Gateway implementation

The potential interactions between the Gateway component, WIS2 and SWIM are illustrated in the figure below⁵⁵



Interactions between the Gateway and components of WIS2 and SWIM

Configuration

Dataset discovery metadata will provide useful information that can be used to configure the Gateway, e.g. the topic(s) to subscribe to plus various other information that may be needed for the SWIM service.

Discovery metadata can be downloaded from the GDC.

Functions

The Gateway component implements the following functions:

⁵⁵ Note that the figure simplifies the transmission of discovery metadata from WIS2 Node to the Global Discovery Catalogue. The WIS2 Node publishes notification messages advertising the availability of new discovery metadata resource at a given URL. These messages are republished by the Global Broker. The Global Discovery Catalogue subscribes to a Global Broker and downloads the discovery metadata from the WIS2 Node using the URL supplied in the message.

- Subscribe to the pertinent topic(s) for notifications about new aeronautical meteorological information⁵⁶
- On receipt of notification messages about newly available data:
 - Parse the notification message, discarding duplicate messages already processed previously.
 - Download the data resource from the WIS2 Node⁵⁷ using the URL in the message – the resource should be in IWXXM format.
 - Create a new "data message" as per the SWIM specifications, including the unique identifier extracted from the data resource⁵⁸, and embedding the aviation weather data resource within the data message.
 - Publish the data message to the appropriate topic on the SWIM Message Broker component of the SWIM service.

The choice of protocol for publishing to the SWIM Message Broker should be based on bilateral agreement between operators of the Gateway and SWIM service.

The Gateway should implement logging and error handling as necessary to enable reliable operations. WIS2 uses the Open Metrics standard⁵⁹ for publishing metrics and other operating information. Use of Open Metrics by the Gateway would enable monitoring and performance reporting to be easily integrated into the WIS2 system.

Operation

The Gateway may be operated at national or regional level depending on the organizational governance in place.

2.8.1.1.5 SWIM service

The SWIM aviation weather information service may comprise of a Message Broker component which implements the AMQP 1.0 messaging standard⁶⁰.

The Message Broker publishes the data messages provided by the Gateway.

The Message Broker must ensure that data messages are provided only by authorized sources such as a Gateway and should validate incoming messages as aeronautical meteorological information.

⁵⁶ WIS2 recommends that one subscribes to notifications from a Global Broker. However, where both Gateway and WIS Node are operated by the same organization, it may be advantageous to subscribe directly to the local message broker of WIS2 Node, e.g. to reduce latency.

⁵⁷ The WIS2 Node may control access to data – the Gateway will need to be implemented accordingly.

⁵⁸ In case a unique identifier is required for proper passing of an aviation weather message to the Gateway, one can use the GTS abbreviated heading (TTAAii CCCC YYGGgg) in the COLLECT envelop (available in IWXXM messages having a corresponding TAC message), or content in attribute **gml:identifier** (available in newer IWXXM messages like WAFS SIGWX Forecast and QVACI), for such purpose. There is currently no agreed definition for unique identifier of IWXXM METAR and TAF reports of individual aerodrome.

⁵⁹ Open Metrics: <https://openmetrics.io>

⁶⁰ AMQP 1.0: <https://www.amqp.org/resources/specifications>

2.8.1.2 The Ocean Data and Information System (ODIS)

The ODIS is a federation of independent data systems coordinated by the International Oceanographic Data and Information Exchange (IODE) of IOC-UNESCO. This federation includes continental-scale data systems as well as those of small organizations. ODIS partners use Web architectural approaches to share metadata describing their holdings, services, and other capacities. In brief, IODE publishes guidelines on how to share metadata as linked open data, serialized in JSON-LD using schema.org⁶¹ semantics. ODIS nodes use these guidelines to publish their metadata catalogues on the Web. This allows all systems with Web connectivity to harvest and merge these catalogues, creating a global map of the ocean data. IODE harvests all metadata shared by ODIS partners, combines it as a knowledge graph, and processes this to export derivative products (e.g. diagnostic reports and cloud-optimized data products). The Ocean Info Hub (OIH) system is IODE's reference implementation of a discovery system leveraging ODIS. The ODIS architecture and tools are Free and Open-Source (FOSS), with regular releases published for the community.

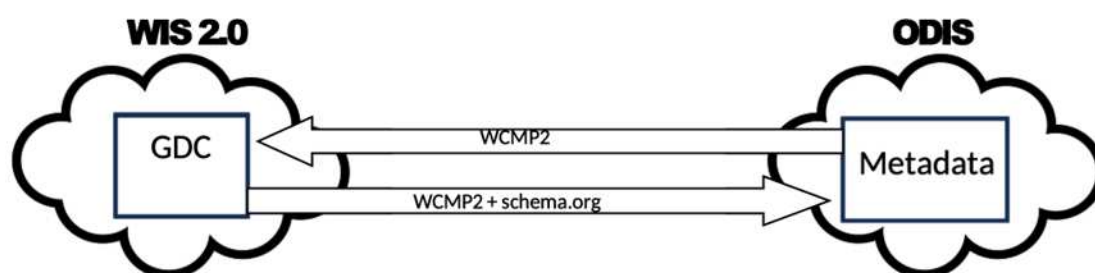
To reach beyond the oceans domain, ODIS works with other data systems and federations, such as WIS2, to define sustainable data and metadata exchanges and – where needed – translators/converters. The resources needed to convert between such systems are developed in the open and in close collaboration with staff from those systems. These exchanges include Extract Transform Load (ETL) functions, to ensure that the bilateral exchange is mutually beneficial.

2.8.1.2.1 Cross system interoperability

Given the strong support for standards and interoperability by both WIS2 and ODIS, data and metadata exchange is realized using Web architectural principles and approaches. The ability to discover ODIS data on WIS2 (as well as the inverse) is a goal in extending the reach of both systems and data beyond their primary communities of interest.

The WIS2 GDC will provide discovery metadata records using the OGC API – Records standard. This will include schema.org and JSON-LD annotations on WCMP2 discovery metadata in the GDC, to enable cross-pollination and federation.

ODIS Dataset records will be made available using the WCMP2 standard and provided as objects available via HTTP for ingest, validation and publication to the GDC as a federated catalogue. ODIS data will be published as recommended data as per the WMO data policy.



WIS2 and ODIS metadata and catalogue interoperability

As a result, federated discovery will be realized between both systems, allowing for use and reuse of data in an authoritative manner, closest to the source of the data.

⁶¹ <https://schema.org>

PART III

3.1 Information management

3.1.1 Introduction

3.1.1.1 Background

The efficient and effective provision of services relying on meteorological, climatological, hydrological, and oceanographic information depends on a reliable information infrastructure. This infrastructure should be guided by community best practices and standards, including recommendations and requirements on sourcing, securing, managing, archiving, exchanging, and providing easy access to information. These terms and activities can be grouped under the term "information management" and this part of the Guide aims to provide high level guidance on those activities. This is done by identifying and describing the fundamental principles of good information management and by highlighting the different stages of the information management lifecycle.

Note: The term "information" is used in a general sense and includes data and products.

3.1.1.2 Scope

High level guidance on information management practices that apply in the context of information related to the Earth system is provided in this part of the Guide. Detailed technical information, such as specification of data formats or quality control and assurance methods, is provided in other parts of the Guide and in other WMO publications. These are referenced where applicable.

The [principles of information management](#) are described below. Five focus areas are described in [the information management lifecycle](#). These are:

1. Planning, information creation and acquisition. Creation of information using internal and external data sources and the acquisition of information from various sources;
2. Representation and metadata. Standards to represent metadata, data and information are of primary importance to enable interoperability and long-term usability of the information;
3. Publication and exchange of information. The creation and publication of discovery metadata in a standardized format enabling users to discover, access and retrieve the information;
4. Usage and communication. Publication of guidance material on the use of published information, including on the limitations and suitability of the information and any licensing terms;
5. Storage, archival and disposal. Policies and procedures for business continuity and disaster recovery, as well-as retention and disposal.

3.1.1.3 Intended audience

This guidance is primarily aimed at personnel within WMO centres, with responsibility for planning and undertaking the creation or acquisition, stewardship, exchange, and provision of information related to the Earth system.

Specifically, the guidance has five main target audiences across the information lifecycle:

1. Information producers or creators (those who produce or acquire the information – they need to ensure the scientific quality of the underpinning information);
2. Information managers (those who manage information);
3. Information providers or publishers (those who publish the information – they are responsible for the provision of the information, and for ensuring that appropriate access is enabled, licensing agreements are in place, etc.).
4. Service providers (those who disseminate the information – they are responsible for ensuring information availability and maintaining capability for easy and secure access to the information);
5. Information consumers (those who utilize the information – they need to understand the restrictions, rights, responsibilities, and limitations associated with the information together with the suitability for intended usage or purpose).

3.1.2 Principles of information management

Effective management of information is essential for WMO centres to deliver operational services and information that is authoritative, seamless, secure, and timely. The principles below underpin this management across the full information lifecycle and provide a framework for information management. The principles are independent of information type and are largely independent of technology, they are therefore expected to remain stable over time.

3.1.2.1 Principle 1: Information is a valued asset

- An information asset is information that has value. This value may be related to the cost of generating and collecting the information, a value associated with the immediate use, or a value associated with the longer-term preservation and subsequent reuse of the information.
- This value should be recognizable and quantifiable, and the asset should have an identifiable lifecycle. Risks associated with, and to, an information asset should also be identified. As such, information management must be considered an integral part of a WMO centre's responsibilities and needs to be adequately resourced over the full lifecycle of the information.

3.1.2.2 Principle 2: Information must be managed

- An information asset must be managed throughout its lifecycle, from creation to use to eventual disposal, in a way that makes it valuable, maximizes its benefits and reflects its value in time and its different uses.
- Information managers must consider the entire information lifecycle, from identifying needs and business cases to creating, quality assurance, maintenance, reuse, archiving, and disposal. Careful consideration must be given to disposal, ensuring that information is destroyed only when it has ceased to be useful for all categories of users.
- Professionally qualified and adequately skilled staff with clear roles and responsibilities should apply a sound custodianship framework concerning security, confidentiality, and other statutory requirements of different types of information.

3.1.2.3 Principle 3: Information must be fit for purpose

- Information should be developed and managed in accordance with its function and use for internal and external users.
- WMO centres should regularly assess information to ensure that it is fit for its purpose and that processes, procedures, and documentation are adequate.
- Processes should be consistent with the general provisions and principles of quality management as described in the *WMO Technical Regulations* (WMO-No. 49).

3.1.2.4 Principle 4: Information must be standardized and interoperable

- Information must be stored and exchanged in standardized formats to ensure wide usability in the short and long-term. It is essential for long-term archiving that information is stored in a form that can be understood and used after several decades.
- Standardization is essential for structured information such as Dataset definitions and metadata to support interoperability.
- Interoperability is essential for users to utilize information through different systems and software. Open standards help ensure interoperability with their openness and wide adoption across various communities.
- Which standards to use depends on the user community and organizational policies. Interoperability requirements should be considered when selecting the standard for internal use and broader dissemination.
- The use of closed and proprietary standards is strongly discouraged.

3.1.2.5 Principle 5: Information must be well-documented

- WMO centres should comprehensively document information processes, policies, and procedures to facilitate broad and long-term use.
- WMO centres should keep documentation up to date to ensure full traceability of processes along the information lifecycle, particularly for its creation.
- Previous versions of the documentation should be retained, versioned, archived and made readily available for future use. In addition, versions should be assigned a unique and persistent identifier for future unambiguous identification.

3.1.2.6 Principle 6: Information must be discoverable, accessible and retrievable

- Information should be easy to find through the Web, and for this purpose, the publisher should share discovery metadata with a catalogue service. The catalogue service should include a Web Application Programming Interface (API) to be used by other applications to offer user-tailored search portals.
- For information to be easily retrievable once discovered, it should be accessible using standard data exchange protocols.

3.1.2.7 Principle 7: Information should be reusable

- To maximize the economic benefits of an information asset it should be made as widely available and as accessible as possible.
- The WMO Unified Data Policy encourages the reuse of data and information through the open and unrestricted exchange of Core WMO data. The WMO encourages the free and unrestricted exchange of information in all circumstances.
- The publisher should provide an explicit and well-defined license for each information item or Dataset as part of the associated metadata.
- The Findable, Accessible, Interoperable and Reusable (FAIR) data principles promote open data with the goal of optimizing reuse of data. These principles should be followed where possible.

Note: Information on the FAIR data principles can be found at: FAIR Principles – GO FAIR ⁶²

3.1.2.8 Principle 8: Information management is subject to accountability and governance.

- Information management processes must be governed as the information moves through its lifecycle. All information must have a designated owner, steward, curator, and custodian. These roles may be invested in the same person but should be clearly defined at the time of creation. A WMO centre with responsibility for managing information must ascertain:
 - Information management practices, procedures, and protocols, including well-defined roles, responsibilities, and restrictions on managing the information.
 - Definition and enforcement of appropriate retention policy, considering stakeholder needs and variations in value over the information lifecycle.
 - Licensing and defining and enforcing any access restrictions.
- The designated owner should have budget and decision-making authority about preservation and data usage, including passing ownership to another authority.

3.1.3 The information management lifecycle

3.1.3.1 Overview

All information should be subject to a well-defined and documented lifecycle. The governance of this process is often referred to as the information management lifecycle and this process helps organizations manage information throughout its full lifecycle, from planning, creation and acquisition through usage and exchange to archival and disposal.

The following sections describe two overarching themes, governance, and documentation, that apply to all stages of the information lifecycle and then provides high level guidance split into five aspects:

- Planning, creation, and acquisition

⁶² <https://go-fair.org>

- Representation and metadata
- Publication and exchange
- Usage and communication
- Storage, archival and disposal

Governance covers the rules that apply to managing information in a secure and transparent manner, documentation covers the act of recording the reasons for, and detail of, all operations in the information management process.

3.1.3.2 Overarching requirements

3.1.3.2.1 Governance

- Information management governance defines a set of organizational procedures, policies, and processes for the management of information. This includes defining accountabilities and compliance mechanisms.
- Effective governance helps ensure that all aspects of the information management process are conducted in a rigorous, standardized, and transparent manner and that the information are secure, accessible, and usable.
- WMO centres should establish a board or leadership group to develop and regularly review such a governance structure and ensure compliance with its requirements.

3.1.3.2.2 Documentation

- Documentation describing the who, what, why, when, where and how various actions are undertaken in the management of information is required to ensure the traceability and integrity of the information and to ensure operations can continue if key staff leave.
- This documentation is required for all aspects of the information lifecycle and should be clear, well-communicated, regularly updated, and easy to find. Guidance to the documentation should be provided to new staff taking on responsibilities for information management and be a key component of training.

3.1.3.3 Aspects of the information management lifecycle

3.1.3.3.1 Planning, information creation and acquisition

Before the creation or acquisition of new information a business case and information management plan should be developed, covering both the input information sources and any derived information. The plans should include:

- Why the information is required
- How it will be collected or created
- How it will be stored
- Whether it will be exchanged with other users and under what policy
- Where it should be submitted for long-term archival
- Key roles and responsibilities associated with the management of the information.

For externally sourced data the plans should include where the information has come from and what the licensing terms are.

Once information has been acquired it should be checked to ensure that the contents and format are as expected. This may be done using a compliance checker or validation service. Once these checks have been performed the information content should also undergo quality control checks using well-documented procedures to identify any issues. A record of the checks should be kept, and any issues detected should be documented and feedback to the originators. It is also important to subscribe to updates from originators so any issues identified externally can be considered.

Information created rather than acquired should undergo the same processes as the acquired information. The information created should undergo quality control and the resulting files checked against the specified format requirements. The results of the processes and checks should be documented.

To ensure traceability and reproducibility the information and documents at this, and subsequent stages, should be version controlled and clearly labelled with version information. Similarly, software, or computer code, used to generate or process information should be version controlled with the version information recorded in the documentation and metadata. Where possible, software should be maintained within a code repository.

3.1.3.3.2 Representation and metadata

The formats used to store and exchange information should be standardized to ensure its usability, both in the short and long-term. It is essential that the information can be accessed many years after archival if required. To ensure this usability, the format and version information should be recorded in the metadata record for the information and should be included in the information where the format allows.

Information exchanged on the WIS and between WMO centres is standardized through the use of the formats specified in the [Manual on Codes](#) (WMO-No. 306), Volume I.2 and the [Manual on WIS](#) (WMO-No. 1060), Volume II. This includes the GRIB and BUFR formats for numerical weather prediction products and observational data and the WIS Core Metadata Profile for discovery, access, and retrieval metadata. The format for the exchange of station and instrumental metadata, the WMO Integrated Global Observing System Branch (WIGOS) Metadata Data Representation, is also defined in the [Manual on Codes](#) (WMO-No. 306), Volume I.3.

These formats have been developed within the WMO community to enable the efficient exchange of information between WMO centres and for the information to be interoperable between centres and systems. The formats, including detailed technical information, have also been published openly through the WMO manuals, enabling use of the formats and information by other communities, promoting reuse of the information.

The WMO formats specified in the manuals are subject to strong governance processes, and changes to the formats can be traced through the versions of the manuals. The code tables and controlled vocabularies are also maintained in a code repository. To enable future reuse, the technical information, including detailed format specifications, should be archived alongside information for future access. This includes any controlled vocabulary, such as BUFR tables or WIGOS metadata code lists, associated with the format.

3.1.3.3.3 Publication and exchange of information

To maximize the benefits and return on investment in the acquisition and generation of information there needs to be a clear method as to how the information will be published, exchanged, and accessed by users.

Information is published on the WIS through the creation of discovery metadata records. These records are publicly searchable and retrievable via WMO cataloguing services, providing access to the records via the Web and via a Web Application Programming Interface (API). The metadata records should include information on how to access the described Datasets and services (see also [Representation and metadata](#)) and how to subscribe to receive updates and new data.

Guidance on the creation of these discovery metadata records is included in Part V of this Guide. Technical Regulations are provided in the [Manual on WIS](#) (WMO-No. 1060), Volume II. Before exchange and publication, the metadata should be assessed using the WMO Core Metadata Profile KPIs to ensure usable and high-quality metadata in addition to metadata that conforms with the technical standard.

The Web standards and protocols used should be adequately documented to enable users to find and retrieve the information. This should be possible both manually and automatically via machine-to-machine interfaces and should be standardized between centres.

Updates to the information exchanged on the WIS, including the publication of new information or the cessation of previously exchanged information, is published in the WMO Operational Newsletter.

Note: The newsletter is available from: <https://community.wmo.int/news/operational-newsletter>

3.1.3.3.4 Usage and communication

For information to have value it must inform users, aid knowledge discovery, and have impact through informed decision-making. Ensuring that the user can make effective use of the information is an important step in the information management lifecycle. This takes two forms:

1. Provision of suitable information within the discovery metadata, enabling users to discover and access the information and to assess whether it meets their requirements. This should include licensing information;
2. Provision of user guides and documentation on the suitability of the information for different uses, including any technical caveats or restrictions on the use of the information.

For common types of information, the guides may be generic or link to standard documentation. Information on the observations available from the WMO Integrated Global Observing System is provided within the [Manual on the WMO Integrated Global Observing System](#) (WMO-No. 1160) and the [Guide to the WMO Integrated Global Observing system](#) (WMO-No. 1165) respectively. This includes information on the expected uses and quality of the data, either directly or through links within. Similarly, information on the data and products available through the Global Data Processing and Forecasting System is provided in the [Manual on the WMO Integrated Processing and Prediction System](#) (formerly *Manual on the Global Data Processing and Forecasting System*) (WMO-No. 485).

For non-standard and specialist products targeted user guides may be more appropriate. These should include a plain text summary for the non-technical user and should also be accessible and retrievable via a link within the discovery metadata. Any user guide should be in addition to the technical documentation described under 3.1.3.3.1 Information Creation and Acquisition.

Updates and the availability of new information should be announced and published via the WMO Operational Newsletter (see [Publication and exchange of information](#)). Other

communication methods may also be used but these should not be in place of the operational newsletter. It is also recommended to allow users to subscribe to receive updates directly.

The discovery metadata should include a valid point of contact, enabling users to provide feedback and ask questions about the information provided.

3.1.3.3.5 Storage, archival and disposal

The type of storage used should be appropriate to the type of information stored. Core information exchanged operationally should be stored and made available via high-availability and low latency media and services. For some operation critical information, such as hazard warnings, there is a requirement for the end-to-end global distribution of the information to be completed in two minutes. For other operational data there is a requirement for the global exchange to be completed in 15 minutes.

The storage requirements for non-operational services and information may be different but the guidance provided in this section applies equally. Further information on the performance requirements is provided within the WI2S Technical Specifications listed in the [Manual on WIS](#) (WMO-No. 1060), Volume II.

Backup policies and data recovery plans should be documented as part of the information management plan. These should be implemented either before or when the information is created or acquired and should include both the information and the associated metadata. The backup and recovery process should be routinely tested. Specific guidance on the expectations and requirements for WMO centres is provided under the operational guidance in Part VII of this Guide.

Business rules governing the access to, and modification of the information should be clearly documented in the information management plan. This must include the clear specification of roles and responsibilities of those managing the information. Information on who can authorize the archival and disposal of the information and the processes for doing so should be included. The roles associated with an information resource are standardized as part of the WIS Core Metadata Profile, see Part V of this Guide for further information.

The archival and long-term preservation of an information resource should be identified and included in the information management plan. This may be at a national data centre and/or a WMO centre. The WMO centres are recommended for globally exchanged Core data and include those centres contributing to the Global Atmosphere Watch, the Global Climate Observing System and the Marine Climate Data System (see [Manual on Marine Meteorological Services](#) (WMO-No. 558), Volume II, as well as the WMO World Data Centres and those defined in the [Manual on WIS](#) (WMO-No. 1060), Volume II and those defined in the [Manual on the WMO Integrated Processing and Prediction System](#) (formerly *Manual on the Global Data Processing and Forecasting System*) (WMO-No. 485).

Earth system information, especially observational data, are often irreplaceable. Other information, while technically replaceable, is often costly to produce and therefore not easily replaceable. This includes output from numerical models and simulations. Before an information resource is marked for disposal careful consideration must be given to whether long-term archival or disposal is more appropriate. This consideration must follow a clearly defined process documented in the information management plan.

When an information resource is marked for disposal the reasons for disposal, including the outcome of the consultation with stakeholders and users, must clearly be documented. The disposal must be authorized by the identified owner and custodian of the information. The information on the disposal must be included in the metadata associated with the information resource. The metadata must be retained for future reference.

3.1.4 Other considerations

3.1.4.1 Technology and technology migration

Information managers must be aware of the need to ensure that the technologies, hardware, and software used do not become obsolete and must be aware of emerging data issues. This topic is discussed further in the [WMO Guidelines on Emerging Data Issues](#) (WMO-No. 1239).

3.1.4.2 Information security

Further information on information security and best practices can be found in the [Guide to Information Technology Security](#) (WMO-No. 1115).

PART IV

4.4 Security

For this initial version of the Guide to WIS2, existing guidance on information technology security (aka. *cybersecurity*) remains largely applicable. Please refer to:

- [Guide to Information Technology Security](#) (WMO-No. 1115)
- [Guide to the WMO Information System](#) (WMO-No. 1061), Vol I, Appendix E – Annex to Paragraph 7.8 (ICT Service Incident Management), and Appendix F – WIS IT Security Incident Response Process

PART V

5.1 Competencies

For this initial version of the Guide to WIS2, existing guidance on competencies remains largely applicable. Please refer to [Guide to the WMO Information System](#) (WMO-No. 1061), Vol I, Appendix A – WIS Training and Learning Guide.

Резолюция 11 (ИНФКОМ-3)

Обновление публикации *Climate Data Management System Specifications* (Спецификации Системы управления климатическими данными) (WMO-No. 1131) и экспериментальное использование Модели основных климатических данных ВМО

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на [резолюцию 23 \(Кг-19\)](#) «Управление климатическими данными в Информационной системе ВМО 2.0»,

отмечая с удовлетворением:

- 1) прогресс, достигнутый Постоянным комитетом по управлению информацией и информационными технологиями (ПК-УИИТ) в сотрудничестве с Постоянным комитетом по климатическому обслуживанию (ПК-КЛИ) в разработке модели климатических данных для поддержки осуществления Членами управления климатическими данными,
- 2) сотрудничество между ПК-КЛИ и ПК-УИИТ в дальнейшей разработке публикации *Climate Data Management System Specifications* (Спецификации Системы управления климатическими данными) (WMO-No. 1131),

принимает к сведению сферу охвата и цель проекта Модели основных климатических данных ВМО, как это предусмотрено в документе INFCOM-3/INF 8.3(6a);

постановляет:

- 1) одобрить проект Модели основных климатических данных ВМО, представленный в документе INFCOM-3/INF-8.3(6a), для экспериментального использования;
- 2) принять предлагаемые поправки к публикации *Climate Data Management System Specifications* (Спецификации Системы управления климатическими данными) (WMO-No. 1131), как описано в дополнении к настоящей резолюции и документе INFCOM-3/INF. 8.3 (6b);
- 3) поручить ПК-УИИТ координировать экспериментальное использование Членами Модели климатических данных, собирать доказательства внедрения и доложить об этой деятельности ИНФКОМ-4

настоятельно призывает Членов поделиться отзывами о внедрении и использовании Модели климатических данных;

просит Генерального секретаря предоставить ресурсы, необходимые для координации тестирования Модели климатических данных среди Членов.

Дополнение к резолюции 11 (ИНФКОМ-3)

Резюме и обоснование обновления публикации *Climate Data Management System Specifications* (Спецификации Системы управления климатическими данными) (WMO-No. 1131)

Climate Data Management System Specifications (Спецификации Системы управления климатическими данными) (WMO-No. 1131) содержат описание и руководящие принципы для системы управления климатическими данными (СУКД) для национальных метеорологических и гидрологических служб (НМГС), с тем чтобы обеспечить рекомендации по функциональности, необходимой для надлежащего управления климатическими данными, и помочь в реализации СУКД Членами. С момента ее первой публикации в 2014 году произошло множество событий, таких как: внедрение Интегрированной глобальной системы наблюдений ВМО, включая Глобальную опорную сеть наблюдений (ГОСН) ([резолюция 2 \(Кг-Внеоч.\(2021\)](#) «Поправки к Техническому регламенту, касающиеся создания Глобальной опорной сети наблюдений»), утверждение Единой политики ВМО в области данных ([резолюция 1 \(Кг-Внеоч.\(2021\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля») и результатов реформы ВМО.

Предлагаемые поправки направлены на приведение публикации *Climate Data Management System Specifications* (Спецификации Системы управления климатическими данными) (WMO-No. 1131) в соответствии с последними техническими регламентами и разработками ВМО и включают обновления, с тем чтобы:

- 1) отразить соответствующие изменения в технических регламентах ВМО (например, Стандарт метаданных Сектора Интегрированной глобальной системы наблюдений ВМО (ИГСНВ), новые сети наблюдений (ГОСН, Региональная опорная сеть наблюдений (РОСН)), обновленный Профиль основных метаданных ВМО);
- 2) обеспечить увязку с наилучшими практиками управления информацией, приведенными в части IV *Руководства по Информационной системе ВМО* (ВМО-№ 1061);
- 3) обеспечить обновленную поддержку ключевой климатической продукции (КЛИМАТ, ежедневные краткие сводки (DAYCLI), климатические нормы ВМО);
- 4) перевести поддержку метаданных источника из разряда рекомендуемого в разряд обязательного компонента.

Полный текст пересмотренной версии см. в документе INFCOM-3/INF. 8.3(6b).

Резолюция 12 (ИНФКОМ-3)

Учреждение Глобального центра сбора данных для морских метеорологических и океанографических климатических данных в рамках Системы морских климатических данных

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ, ссылаясь на [резолюцию 23 \(Кг-19\)](#) «Управление климатическими данными в Информационной системе ВМО 2.0»,

вновь подтверждая подход, основанный на системе Земля, и важную роль совместной Системы морских климатических данных ВМО/МОК в долгосрочном управлении морскими климатическими данными на региональном и глобальном уровнях,

отмечая с удовлетворением:

- 1) представление центром «Кориолис», размещенном во Французском научно-исследовательском институте по освоению моря (ИФРЕМЕР), заявки на получение статуса Глобального центра сбора данных для заякоренных буев в рамках Системы морских климатических данных,
- 2) оценку, проведенную специальной группой экспертов, состоящей из представителей, назначенных ВМО и группой экспертов МООД по практикам управления и обмена биологическими и химическими данными (ГЭ-БИХ), включая ее рекомендацию, о чем сообщается в документе INFCOM-3/INF. 8.3 (6с),

постановляет учредить в центре «Кориолис» (в ИФРЕМЕР) Глобальный центр сбора данных для заякоренных буев в рамках Системы морских климатических данных;

порукает Постоянному комитету по управлению информацией и информационным технологиям (ПК-УИИТ) в сотрудничестве с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) включить новый Глобальный центр сбора данных

в соответствующее Руководство в рамках гармонизации технических регламентов и руководств, связанных с климатическими данными и наблюдениями, в соответствии с [резолюцией 23 \(Кг-19\)](#) «Управление климатическими данными в Информационной системе 2.0».

ПРИЛОЖЕНИЕ 3. РЕШЕНИЯ, ПРИНЯТЫЕ СЕССИЕЙ

Решение 1 (ИНФКОМ-3)

Доклад президента Комиссии, в том числе доклады председателей вспомогательных органов

Комиссия по наблюдениям, инфраструктуре и информационным системам,

отмечая доклад президента Комиссии, представленный в документе INFCOM-3/INF. 2, который включает доклад президента Комиссии и председателей вспомогательных органов,

постановляет рассмотреть рекомендации Группы управления, постоянных комитетов, исследовательских групп и консультативных групп Комиссии по соответствующим пунктам повестки дня.

Более подробную информацию см. в документе INFCOM-3/INF. 2.

Обоснование решения: в докладе президента Комиссии по наблюдениям, инфраструктуре и информационным системам, представленном в документе INFCOM-3/INF. 2, освещается прогресс в деятельности Комиссии и ее вспомогательных органов со времени второй сессии Комиссии (ИНФКОМ-2), 22—26 октября 2022 г.) в соответствии с [резолюцией 1 \(ИНФКОМ-2\)](#) «Программа работы Комиссии».

Примечание: настоящее решение заменяет [решение 2 \(ИНФКОМ-2\)](#), которое больше не имеет силы.

Решение 2 (ИНФКОМ-3)

Проекты резолюций, решений и рекомендаций, подлежащие принятию консенсусом без обсуждения

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет утвердить консенсусом и без обсуждений документы, содержащие следующие проекты резолюций, решений и рекомендаций:

- 1) [решение 1 \(ИНФКОМ-3\)](#) «Доклад президента Комиссии, в том числе доклады председателей вспомогательных органов»;
- 2) [резолюция 1 \(ИНФКОМ-3\)](#) «Рассмотрение ранее вынесенных резолюций и рекомендаций Комиссии»;
- 3) [решение 3 \(ИНФКОМ-3\)](#) «Рассмотрение резолюций и решений Конгресса и Исполнительного совета, относящихся к Комиссии»;
- 4) [резолюция 4 \(ИНФКОМ-3\)](#) «Обновление *Руководства по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1165)»;

- 5) [резолюция 5 \(ИНФКОМ-3\)](#) «Обновление *Технических руководящих принципов для региональных центров ИГСНВ по системе мониторинга качества данных ИГСНВ* (ВМО-№ 1224)»;
- 6) [решение 8 \(ИНФКОМ-3\)](#) «План обновления *Перспективного видения в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году* (ВМО-№ 1243) и *Руководящих указаний высокого уровня по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение* (ВМО-№ 1334)»;
- 7) [резолюция 6 \(ИНФКОМ-3\)](#) «Обновление *Руководящих принципов по наилучшим практикам обеспечения готовности пользователей к использованию метеорологических спутников нового поколения* (ВМО-№ 1187)»;
- 8) [резолюция 7 \(ИНФКОМ-3\)](#) «Обновление *Руководства по приборам и методам наблюдений* (ВМО-№ 8)»;
- 9) [резолюция 8 \(ИНФКОМ-3\)](#) «Обновление *Руководства по передовой практике использования оперативных метеорологических радиолокаторов* (ВМО-№ 1257)»;
- 10) [резолюция 9 \(ИНФКОМ-3\)](#) «Обновление *Руководства по гидрологической практике, том I* (ВМО-№ 168)»;
- 11) [решение 13 \(ИНФКОМ-3\)](#) «Руководящие принципы проведения взаимосравнений радиометров»;
- 12) [резолюция 10 \(ИНФКОМ-3\)](#) «Обновление *Руководства по Информационной системе ВМО* (ВМО-№ 1061)»;
- 13) [резолюция 11 \(ИНФКОМ-3\)](#) «Обновление *публикации Climate Data Management System Specifications* (Спецификации Системы управления климатическими данными) (WMO No. 1131) и экспериментальное использование Модели основных климатических данных ВМО»;
- 14) [резолюция 12 \(ИНФКОМ-3\)](#) «Учреждение Глобального центра сбора данных для морских метеорологических и океанографических климатических данных в рамках Системы морских климатических данных»;
- 15) [рекомендация 8 \(ИНФКОМ-3\)](#) «Поправки к *Наставлению по кодам* (ВМО-№ 306), том I.2»;
- 17) [решение 20 \(ИНФКОМ-3\)](#) «Дорожная карта по интеграции криосферы в Комплексную систему обработки и прогнозирования ВМО»;
- 18) [решение 34 \(ИНФКОМ-3\)](#) «Дата и место проведения следующих сессий ИНФКОМ».

Обоснование решения: [правило 3.10 Правил процедуры для технических комиссий](#) (ВМО-№ 1240, издание 2023 г.). Дополнительно был рассмотрен вопрос об организации 5-дневной сессии.

Решение 3 (ИНФОМ-3)

Рассмотрение резолюций и решений Конгресса и Исполнительного совета, относящихся к Комиссии

Комиссия по наблюдениям, инфраструктуре и информационным системам,

рассмотрев документ INFCOM-3/INF. 4.2, в котором кратко изложены действия, предпринятые по резолюциям и решениям Конгресса и Исполнительного совета, касающимся Комиссии,

- 1) **принимает к сведению** директивы, адресованные Конгрессом и Исполнительным советом Комиссии и президенту;
- 2) **одобряет** меры, принятые к настоящему моменту в ответ на такие директивы;
- 3) **просит** президента при поддержке Секретариата включить нерешенные задачи в программу работы Комиссии.

Дополнительную информацию см. в INFCOM-3/INF. 4.2.

Обоснование решения: [правило 6.13.1 i\) Правил процедуры для технических комиссий](#) (ВМО-№ 1240, издание 2023 г.); [правило 153 7\) Общего регламента \(Сборник основных документов № 1](#) (ВМО-№ 15))

Примечание: настоящее решение заменяет [решение 4 \(ИНФОМ-2\)](#), которое более не имеет силы.

Решение 4 (ИНФОМ-3)

Председатели и заместители председателей постоянных комитетов, исследовательских и консультативных групп и координаторы

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

- 1) утвердить рекомендации избранных должностных лиц в отношении следующих председателей и заместителей председателей постоянных комитетов, исследовательских и консультативных групп и координаторов:
 - a) Постоянный комитет по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ):
 - i) председатель: Эстель ГРЮТЕР (Швейцария);
 - ii) со-вице-председатель: Шеннон КАЙЯ (Канада);
 - iii) со-вице-председатель: Мартина СУАЙЯ (Аргентина);
 - b) Постоянный комитет по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП):

- i) председатель: Джейн УОРН (Австралия);
 - ii) со-вице-председатель: Цзюньхун ВАН (Соединенные Штаты Америки);
 - iii) со-вице-председатель: Цзянькай ВАН (Китай);
- c) Постоянный комитет по управлению информацией и информационным технологиям (ПК-УИИТ):
 - i) председатель: Реми ЖИРО (Франция);
 - ii) со-вице-председатель: Джереми ТЭНДИ (Соединенное Королевство);
 - iii) со-вице-председатель: Лэй СЮЭ (Китай);
- d) Постоянный комитет по Комплексной системе обработки и прогнозирования ВМО (ПК-КСОПВ):
 - i) председатель: Дэвид РИЧАРДСОН (Европейский центр среднесрочных прогнозов погоды);
 - ii) со-вице-председатель: Хамза КАБЕЛВА (Объединенная Республика Танзания);
 - iii) со-вице-председатель: Юхэй ТАКАЯ (Япония);
- e) Исследовательская группа по вопросам экологической устойчивости (ИГ-ЭКОУ):
 - i) председатель: Карен ГРИССОМ (Соединенные Штаты Америки);
 - ii) заместитель председателя: [вакантно] (...);
- f) Исследовательская группа по будущей инфраструктуре данных (ИГ-БИД)
 - i) председатель: Вероник БУШЕ (Канада);
 - ii) заместитель председателя: [вакантно] (...);
- g) Исследовательская группа по оценке, назначению и обзору соответствия центров (ИГ-ОНОС)
 - i) председатель: [...] (...),
 - ii) заместитель председателя: Бушра ЭЛЬ-ДЖОХРА (Марокко);
- h) Консультативная группа по Глобальной службе криосферы (КГ-ГСК):
 - i) председатель: Скотт ЛИНДСИ (Соединенные Штаты Америки);
 - ii) со-вице-председатель: Йёрн КРИСТИАНСЕН (Норвегия);
 - iii) со-вице-председатель: Виджай СОНИ (Индия);
- i) Консультативная группа по океанам (КГ-Океан):
 - i) председатель: Борис КЕЛЛИ-ГЕРРЕЙН (Австралия);
 - ii) со-вице-председатель: Кэти ХИЛЛ (Соединенное Королевство);
 - iii) со-вице-председатель: Алехандро ДЕ ЛА МАСА (Чили);

- j) Консультативная группа по гидрологии (КГ-Гидро):
 - i) председатель: [вакантно] (...),
 - ii) заместитель председателя: Паулина МУФЕТИ (Намибия);
 - k) Координатор по осуществлению Единой политики ВМО в области данных (К-ДАТА):
 - i) координатор: [вакантно] (...)
 - l) Координатор по развитию потенциала (К-РП):
 - i) координатор: [вакантно] (...)
- 2) поручить президенту в консультации с Группой управления и при поддержке Секретариата обеспечить отбор кандидатов для заполнения вышеуказанных вакантных должностей в соответствии с поручением Комиссии согласно [Правилам процедуры технических комиссий](#) (ВМО-№ 1240, издание 2023 г.), учитывая всеобъемлющие принципы отбора экспертов, обслуживающих вспомогательные органы, представленные в INFCOM-3/INF. 6.2.

Более подробную информацию см. в документе INFCOM-3/INF. 6.2.

Обоснование решения: правило 5.2 [Правил процедуры для технических комиссий](#) (ВМО-№ 1240, издание 2023 г.).

Примечание: настоящее решение вместе с [решением 5 \(ИНФОМ-3\)](#) заменяет [резолюцию 3 \(ИНФОМ-2\)](#), которая более не имеет силы.

Решение 5 (ИНФОМ-3)

Состав Группы управления Комиссии

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

- 1) утвердить состав Группы управления Комиссии на следующий межсессионный период:
 - a) избираемые должностные лица: президент и до трех со-вице-президентов,
 - b) председатель, сопредседатели, заместитель председателя, со-вице-председатели постоянных комитетов, исследовательских и консультативных групп,
 - c) координаторы по развитию потенциала и осуществлению Единой политики ВМО в области данных,
 - d) по одному представителю от каждой рабочей группы/комитета по инфраструктуре шести региональных ассоциаций (РА) (если они еще не включены в пункты b) и c) выше) на основе соглашения между президентом каждой РА и президентом,
 - e) председатель Руководящего комитета Глобальной системы наблюдений за климатом (ГСНК) в качестве члена в силу занимаемой должности,

- f) председатель Руководящего комитета Глобальной системы наблюдений за океаном (ГСНО) в качестве члена в силу занимаемой должности,
 - g) представитель КГМС в качестве члена в силу занимаемой должности;
- 2) уполномочить президента, в консультации с президентами РА и Группой управления Комиссии, назначить членов, представляющих каждую рабочую группу/комитет по инфраструктуре РА, с учетом всеобъемлющих принципов отбора экспертов, обслуживающих вспомогательные органы, представленных в документе INFCOM-3/INF. 6.2;
 - 3) уполномочить президента назначать дополнительных членов Группы управления в связи с учреждением рабочих групп в межсессионный период, в том числе тех, которые запрошены в [резолюции 3 \(ИНФКОМ-3\)](#);
 - 4) поручить Группе управления задействовать возможности, которые обеспечивает членство представителей совместно спонсируемых программ и партнерских организаций, для обеспечения эффективного сотрудничества.

Более подробную информацию см. в документе INFCOM-3/INF. 6.2.

Обоснование решения: правило 5.5.6 и Приложение III к [Правилам процедуры для технических комиссий](#) (ВМО-№ 1240, издание 2023 г.), резолюция 40 (Кг-19) «Меры по содействию широкому, прозрачному и экологически устойчивому управлению».

Примечание: настоящее решение вместе с [решением 4 \(ИНФКОМ-3\)](#) заменяет [резолюцию 3 \(ИНФКОМ-2\)](#), которая более не имеет силы.

Решение 6 (ИНФКОМ-3)

Приоритетные виды деятельности Комиссии по наблюдениям, инфраструктуре и информационным системам (ИНФКОМ), способствующие осуществлению инициативы «Заблаговременные предупреждения для всех»

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

- 1) одобрить перечень приоритетных видов деятельности Комиссии, способствующих осуществлению инициативы «Заблаговременные предупреждения для всех» (ЗПДВ), представленный в дополнении к настоящему решению, который отражает приоритеты, обозначенные Членами в процессе обзора, проведенного региональными ассоциациями;
- 2) поручить вспомогательным органам ИНФКОМ включить их в свои соответствующие программы работы;
- 3) принять к сведению сводный перечень приоритетных видов деятельности ИНФКОМ, Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) и Совета по исследованиям, представленный в документе INFCOM-3/INF. 7.1;

настоятельно призывает Членов, представленных в ИНФКОМ, оказать поддержку осуществлению перечисленных приоритетных мероприятий путем разработки собственных инициатив на региональном и/или национальном уровнях в сотрудничестве с различными заинтересованными сторонами, включая многосторонних/двусторонних партнеров по развитию.

Более подробную информацию см. в документе INFCOM-3/INF. 7.1.

Обоснование решения: [резолюция 4 \(Кг-19\)](#) «Инициатива Организации Объединенных Наций „Заблаговременные предупреждения для всех“», в которой содержится поручение техническим комиссиям:

- 1) определять приоритетные виды деятельности по удовлетворению насущных потребностей Членов при создании эффективных СЗПМОЯ и включать их в их соответствующие планы работы на следующий финансовый период;
- 2) выявлять, каталогизировать и интегрировать приоритетные возникающие опасные явления, такие как опасные явления, связанные с изменениями в криосфере, в поддержку разработки необходимых систем мониторинга и заблаговременных предупреждений для затрагиваемых этими явлениями Членов;
- 3) осуществлять приоритетные виды деятельности на основе сотрудничества, скоординированным и согласованным образом и регулярно докладывать Исполнительному совету.

Дополнение к решению 6 (ИНФКОМ-3)

Перечень приоритетных видов деятельности ИНФКОМ, способствующих осуществлению инициативы «Заблаговременные предупреждения для всех»

- 1) Осуществление Информационной системы ВМО (ИСВ) 2.0, включая разработку редактора Протокола общего оповещения (САР), который станет частью «ИСВ 2.0 в коробке», и развитие Системы гидрологических наблюдений ВМО (СГНВ) на предоперативном этапе ИСВ 2.0.
- 2) Осуществление Глобальной опорной сети наблюдений (ГОСН), в том числе за счет (поддержки, оказываемой / в рамках) ФФСН.
- 3) Руководство и поддержка развития Региональной опорной сети наблюдений (РОСН).
- 4) Анализ пробелов и совершенствование продукции Комплексной системы обработки и прогнозирования ВМО (КСОПВ) для приоритетных опасных явлений, включая:
 - a) укрепление процесса каскадирования информации и обслуживания в рамках Программы по прогнозированию явлений суровой погоды (ППСП), Информационной системы климатического обслуживания (ИСКО) и Программы по тропическим циклонам (ПТЦ);
 - b) повышение доступности и удобства использования продукции КСОПВ, включая графическую продукцию.

- 5) Расширение участия представителей научных кругов и частного сектора в развитии КСОПВ.
 - 6) Активизация внедрения новейших технологических (например, искусственного интеллекта (ИИ)) и научных достижений в КСОПВ.
 - 7) Каталогизация и анализ пробелов в спутниковой продукции и применениях в области приоритетных опасных явлений.
 - 8) Оказание поддержки Членам в обеспечении доступа к спутниковым данным и продукции, а также в подготовке инструкторов по вопросам доступа, обработки, визуализации и интерпретации спутниковых данных.
 - 9) Реагирование на потребности в связи с возникающими опасными явлениями, связанными с криосферой.
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Решение 7 (ИНФКОМ-3)

Исследовательская группа по вопросам экологической устойчивости

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

- 1) соблюдать приверженность ВМО достижению устойчивого и жизнестойкого мира с чистыми нулевыми выбросами для всех, включая экологически устойчивый подход к наблюдению за погодой и климатом, как указано в Стратегическом плане (2024–2027 гг.);
- 2) напомнить о том, что деятельность ИНФКОМ способствует снижению воздействия на окружающую среду целого ряда мероприятий;
- 3) придерживаться сбалансированного подхода, позволяющего выполнять свой основной мандат и одновременно обеспечивать применение экологически устойчивых подходов для снижения общего воздействия на окружающую среду, связанного с деятельностью Комиссии;
- 4) признать необходимость разработки руководящих материалов по внедрению методов обеспечения экологической устойчивости для поддержки всех Членов;
- 5) подчеркнуть важность тесного сотрудничества с промышленностью для разработки и внедрения экологически устойчивых систем и методов наблюдения;
- 6) учредить Исследовательскую группу по вопросам экологической устойчивости (ИГ-ЭКОУ) с кругом ведения, приведенным в дополнении к настоящему решению, которое предлагается принять в качестве части дополнения к [резолюции 4 \(ИНФКОМ-3\)](#);
- 7) поручить всем постоянным комитетам и консультативным группам ИНФКОМ учитывать экологическую устойчивость при разработке и осуществлении своей деятельности.

Более подробную информацию см. в документе INFCOM-3/INF. 7.3.

Обоснование решения: экологическая устойчивость определена как стратегическая задача 5.4 Долгосрочной цели 5 и как одно из приоритетных направлений 2.1 Долгосрочной цели 2 *Стратегического плана ВМО на 2024—2027 годы* (ВМО-№ 1336), принятого в *резолюции 2 (Кг-19)* «Стратегический план ВМО на 2024—2027 годы». До сих пор мероприятия ИНФКОМ, связанные с экологической устойчивостью, координировались координатором в сотрудничестве с одним из вице-президентов ИНФКОМ и касались экологически безопасных стратегий в контексте реализации Глобальной опорной сети наблюдений (ГОСН). В Стратегическом плане ВМО (2024—2027 гг.) принята гораздо более масштабная цель, связанная с экологической устойчивостью, — достижение чистого нулевого уровня выбросов. Следовательно, мандат ИНФКОМ в этой области расширяется, охватывая всю ее деятельность, и требует более тесного сотрудничества в рамках Комиссии для достижения желаемого результата. Создание Исследовательской группы по вопросам экологической устойчивости позволит обмениваться опытом в этой новой области работы и будет способствовать внедрению скоординированного подхода во всех вспомогательных органах ИНФКОМ. В решении 5.1 (INFCOM-MG-H2) также было выражено согласие с необходимостью расширения деятельности ИНФКОМ в области экологической устойчивости.

Дополнение к решению 7 (ИНФКОМ-3)

*[Утвержденный круг ведения включен в дополнение к *резолюции 3 (ИНФКОМ-3)*]*

Решение 8 (ИНФКОМ-3)

План обновления Перспективного видения в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году (ВМО-№ 1243) и Руководящих указаний высокого уровня по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение (ВМО-№ 1334)

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

- 1) инициировать обновление *Перспективного видения в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году* (ВМО-№ 1243);
- 2) инициировать обновление Руководящих указаний высокого уровня по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение (ВМО-№ 1334) в соответствии с поручениями девятнадцатого Всемирного метеорологического конгресса (Кг-19).

Комиссия по наблюдению, инфраструктуре и информационным системам далее постановляет поручить Постоянному комитету по системам наблюдений за Землей и сетям мониторинга:

- 3) руководить процессом обновления обеих публикаций и принимать необходимые меры для того, чтобы эти обновления были представлены на четвертой сессии ИНФКОМ для одобрения;
 - 4) провести широкие консультации с широким кругом заинтересованных сторон, таких как национальные метеорологические и гидрологические службы (НМГС), космические агентства, соответствующие международные организации и программы, разработчики систем наблюдений, а также другие представители частного сектора и академических кругов, что позволит внести соответствующий вклад в обновление обеих публикаций.
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Обоснование решения:

Перспективное видение в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году (ВМО-№ 1243)

Новые тенденции в возможностях и потребностях в предоставлении обслуживания, технологические инновации, быстрое развитие информационных технологий и систем связи, изменение потребностей пользователей в данных наблюдений как ключевых движущих факторах метеорологического, гидрологического, климатического и смежного обслуживания в области окружающей среды, а также новые инициативы, такие как инициатива ООН «Заблаговременные предупреждения для всех», требуют обновления текущего перспективного видения, которое не учитывает всех этих факторов.

Более того, текущее планирование программ эксплуатации и замены спутников (космического базирования) уже распространяется на период после 2040 года.

Приняв во внимание текущие потребности, ИНФКОМ постановляет провести необходимое обновление Перспективного видения в отношении ИГСНВ в следующий межсессионный период с целью одобрить обновленное перспективное видение на своей четвертой сессии и предусмотреть ее представление двадцатой сессии Конгресса в 2027 году для ее утверждения.

В процессе обновления Перспективного видения в отношении ИГСНВ крайне важно будет обеспечить широкие консультации с широким кругом заинтересованных сторон, таких как НМГС, космические агентства, соответствующие международные организации и программы, разработчики систем наблюдения и другие представители частного сектора и академических кругов.

Руководящие указания высокого уровня по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение (ВМО-№ 1334)

Кг-19 поручил президенту ИНФКОМ отслеживать осуществление [резолюции 20 \(Кг-19\)](#) «Руководящие указания высокого уровня по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение в отношении Интегрированной глобальной системы наблюдений ВМО (ИГСНВ) в 2040 году», рассмотреть вопрос о том, можно ли и каким образом преобразовать конкретные приоритетные действия из *Руководящих указаний высокого уровня по эволюции глобальных систем наблюдений в период 2023—2027 годов* в ответ на Перспективное видение (ВМО-№ 1334) в новый или обновленный технический регламент, и предложить обновление этой публикации с тем, чтобы отразить изменение потребностей конечных пользователей и технологий наблюдений.

Принимая во внимание поручения Кг-19 и текущие потребности, ИНФКОМ постановляет провести необходимое обновление публикаций Руководящих указаний высокого уровня (РУВУ) в следующий межсессионный период с целью одобрения обновленного Перспективного видения на своей четвертой сессии и представления обновленных версий на двадцатой сессии Конгресса в 2027 году для их утверждения.

Важнейшую роль будет играть обеспечение соответствующих вкладов в обновление публикаций РУВУ посредством заявлений о руководящих принципах по каждой категории применений системы Земля в рамках процесса регулярного обзора потребностей ИГСНВ и обеспечение широких консультаций со всеми участниками этого процесса.

Решение 9 (ИНФОМ-3)**Расширение Глобальной опорной сети наблюдений (ГОСН)****Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:**

поручить Постоянному комитету по системам наблюдений за Землей и сетям мониторинга (ПК-CHSM):

- 1) подготовить поэтапную дорожную карту для развития и расширения ГОСН, в которой сбалансирована необходимость устойчивого обеспечения первоначальной сети ГОСН в соответствии с требуемой спецификацией и стремление расширить сферу охвата ГОСН на другие области и переменные :
 - a) продолжая текущую работу, ориентированную на гидрологические переменные;
 - b) в рамках текущей сферы охвата ГОСН для глобальных численных прогнозов погоды и реанализа климата путем:
 - i) изучения потенциальных океанических и криосферных переменных ГОСН в сотрудничестве с Глобальной системой наблюдений за океаном (ГСНО), Консультативной группой по океанам (КГ-Океан) и Консультативной группой Глобальной службы криосферы (КГ-ГСК), а также
 - ii) рассмотрения возможности внесения изменений в Технический регламент, которые окажут большое влияние на реанализ климата, максимально расширяя связи с Глобальной системой наблюдений за климатом (ГСНК);
 - c) рассматривая возможность расширения ГОСН для включения областей применения мониторинга климата в сотрудничестве с ГСНК, с использованием концепции основных климатических переменных (ОКП) и в сотрудничестве с Глобальной службой наблюдения за парниковыми газами (ГСНПГ);
 - d) подчеркивая вклад в Стратегический план ВМО на 2024—2027 годы и приоритеты ВМО при рассмотрении дополнительных областей применения ГОСН;
- 2) подготовить рекомендацию для Кг-Внеоч.(2025) вместе с этой дорожной картой с целью предложить измененный Технический регламент, касающийся ГОСН, на Кг-20 в 2027 году.

Обоснование решения:

[резолюция 2 \(Кг-Внеоч.\(2021\)\)](#) «Поправки к Техническому регламенту, касающиеся создания Глобальной опорной сети наблюдений»;

[резолюция 4 \(Кг-Внеоч.\(2021\)\)](#) «Перспективное видение и Стратегия ВМО в области гидрологии и соответствующий План действий»;

[решение 6 \(ИС-75\)](#) «Исследование возможности интеграции дополнительных гидрологических и криосферных переменных в Глобальную опорную сеть наблюдений».

Решение 10 (ИНФОМ-3)

Метаданные и инструменты Глобальной опорной сети наблюдений

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

поручить Постоянному комитету по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ) в сотрудничестве с Постоянным комитетом по управлению информацией и информационным технологиям (ПК-УИИТ) изучить [Стандарт метаданных ИГСНВ](#) (ВМО-№ 1192) и инструменты информационного ресурса ИГСНВ (включая ОСКАР, СМКДИ и мониторинг соответствия требованиям ГОСН), с тем чтобы:

- 1) рассмотреть необходимость отслеживания Членами своего вклада в ИГСНВ для всех мест наблюдений, надзор за которыми они осуществляют;
- 2) изучить надлежащие процедуры для определения Членами ВМО мониторинга соответствия станций/платформ наблюдений в инструментах информационного ресурса ИГСНВ;
- 3) проанализировать необходимость внесения любых других изменений в Стандарт метаданных ИГСНВ и их последствия для инструментов и руководящих принципов информационного ресурса ИГСНВ; и
- 4) рассмотреть в рамках данного процесса важность того, чтобы не прерывать оперативный поток метаданных и данных для важных метеорологических, климатических, гидрологических, морских и смежных применений в области окружающей среды в соответствии с Единой политикой ВМО в области данных ([резолюция 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля»);

поручить далее ПК-СНСМ разработать руководящий материал по выполнению рекомендаций ГОСН в отношении высокой плотности при наличии возможностей, соответственно, и отчитаться перед ИНФОМ-4.

Решение 11 (ИНФОМ-3)

Решение о докладе по глобальным центрам гидрологических данных ВМО

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на [резолюцию 25 \(Кг-18\)](#) «Основные инициативы в области гидрологии», в которой Глобальная сеть наблюдений за поверхностью суши — гидрология (ГСНПС-Г) признается, в частности, в качестве одной из фундаментальных основ для достижения долгосрочных крупномасштабных целей оперативного гидрологического сообщества,

учитывая важность включения надежных гидрологических наблюдений и данных в Интегрированную глобальную систему наблюдений ВМО (ИГСНВ) и Информационную систему ВМО (ИСВ),

учитывая далее возможности Глобальной сети наблюдений за поверхностью суши — гидрология (ГСНПС-Г) и интегрированных в нее глобальных центров гидрологических данных для описания развития глобального круговорота воды, достижения целей Е и I «качество воды известно» Плана действий в области гидрологии на 2022—2030 годы,

признавая успехи в области разработки и расширения Системы гидрологических наблюдений ВМО (СГНВ)

приняв к сведению доклад «Оценка и будущая роль глобальных центров гидрологических данных ВМО» (см. документ INFCOM-3/INF. 8.1(6)) и содержащиеся в нем рекомендации,

постановляет:

- 1) разработать в сотрудничестве с Глобальной сетью наблюдений за поверхностью суши — гидрология (ГСНПС-Г) и глобальными центрами гидрологических данных ВМО (Глобальный центр данных по стоку (ГЦДС), Международный центр по оценке ресурсов подземных вод (МЦОРПВ), Международный центр данных по гидрологии озер и водохранилищ (ГИДРООЗВО) и Глобальный центр климатологии осадков (ГЦКО)) подробный план работы, основанный на докладе «Оценка и будущая роль глобальных центров гидрологических данных ВМО» (документ INFCOM-3/INF. 8.1(6));
- 2) изучить возможности других оперативных глобальных центров данных по воде, интегрированных в ГСНПС-Г, в частности Международной сети мониторинга влажности почвы (МСМВП), для улучшения функциональной совместимости в рамках системы ООН в отношении наблюдений за пресной водой в рамках всего глобального круговорота воды;

первоочередное внимание будет уделено следующим задачам:

- a) повышение операционной совместимости набора данных и продукции и укрепление интеграции между ними в целях обеспечения комплексного подхода к водному циклу;
- b) осуществление резервного копирования данных для тех НГС и других организаций, которые еще не располагают собственной системой резервного копирования данных;
- c) налаживание сотрудничества с Программой Организации Объединенных Наций по окружающей среде (ЮНЕП), Программой водных ресурсов Глобальной системы мониторинга окружающей среды (ГСМОС) и ее Центром данных ГСМОС/по воде, расположенным в Федеральном институте гидрологии Германии (BfG) и Международном центре по водным ресурсам и глобальным изменениям (МЦВРГ) — центре ЮНЕСКО категории 2 в целях обеспечения комплексного подхода к сбору глобальных данных и распространению продукции с учетом качества/количества воды;
- d) предоставление информации для ГидроСОП и составления докладов о состоянии глобальных водных ресурсов;
- e) поддержка программы обучения ВМО по сбору гидрологических данных и управлению ими, а также по обеспечению и контролю их качества (ОК/КК);
- f) разработка процедуры регулярного предоставления центрам соответствующих данных;

проект плана будет представлен Комиссии для утверждения в 2026 году на ее четвертой сессии;

- 3) содействовать посредством разработки необходимых технических стандартов на основе ИСВ 2.0 и СГНВ тому, чтобы Члены Организации регулярно предоставляли в эти центры данные за прошлые периоды и, когда это возможно, данные во времени, близком к реальному;
- 4) обеспечить глобальным центрам гидрологических данных ВМО возможность доступа к данным с использованием ИСВ 2.0 и СГНВ.

Более подробную информацию см. в документе INFCOM-3/INF. 8.1(6).

Обоснование решения: в докладе «Оценка и будущая роль глобальных центров гидрологических данных ВМО» (см. документ INFCOM-3/INF. 8.1(6)) содержится подробная информация о текущем состоянии и будущей роли глобальных центров гидрологических данных ВМО, а также рекомендации по достижению соответствующих целей. Доклад служит основой для разработки подробного плана работы с целью создать условия для регистрации этих центров в качестве центров ВМО (ИГСНВ и/или ИСВ). В проекте плана будут рассмотрены рекомендация и предлагаемые функциональные возможности, включенные в доклад, оценена их целесообразность и указаны конкретные шаги и меры по их осуществлению, в частности разработка единого процесса с подробным описанием того, каким образом Члены Организации могут предоставлять данные центрам. В дальнейшем ВМО будет способствовать осуществлению единого процесса среди ее Членов.

Решение 12 (ИНФОМ-3)

Дальнейшая разработка требований к оперативной неопределенности измерений (Руководство по приборам и методам наблюдений (ВМО-№ 8), том I, глава 1, приложение 1.A)

Комиссия по наблюдениям, инфраструктуре и информационным системам,

с удовлетворением отмечая усилия Постоянного комитета по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП), направленные на обеспечение применимой и однозначной интерпретации требований к неопределенности измерений,

постановляет:

- 1) одобрить предложение, изложенное в документе INFCOM-3/INF. 8.2(2), о дальнейшей разработке существующих требований к оперативной неопределенности измерений и рабочим характеристикам приборов, приведенных в томе I, главе 1, приложении 1.A к [Руководству по приборам и методам наблюдений](#) (ВМО-№ 8), и об их объединении во всеобъемлющую систему, которая будет приведена в соответствие с Классификациями качества измерений для наземных станций приземных наблюдений (том I, глава 1, приложение 1.G к [Руководству по приборам и методам наблюдений](#) (ВМО-№ 8)) и позволит обеспечить однозначную и интерпретируемую связь с Инструментом анализа и обзора возможностей систем наблюдений (ОСКАР)/Потребности;
- 2) поручить ПК-ИПП осуществление дальнейшей разработки требований и возглавить работу по созданию соответствующего инструмента, предпочтительно в рамках базы данных ОСКАР, в целях обеспечения функционирования новой системы.

Более подробную информацию см. в документе INFCOM-3/INF. 8.2(2).

Обоснование решения:

Существующие требования к оперативной неопределенности измерений и рабочим характеристикам приборов, приведенные в том I, главе 1, приложении 1.А к [Руководству по приборам и методам наблюдений](#) (ВМО-№ 8), являются неполными и не представляют собой надлежащие, легко и однозначно интерпретируемые требования ввиду недавнего выхода в свет новых материалов на тему неопределенности, в числе которых, например, Классификации качества измерений для наземных станций приземных наблюдений (ККИ). Кроме того, представляется затруднительным использовать существующие требования таким образом, чтобы они были пригодны для разработки условий проведения торгов, а также установить четкую связь с потребностями пользователей в наблюдениях, указанными в базе данных ОСКАР/Потребности.

ПК-ИПП через свою Экспертную группу по неопределенности измерений уже приступил к обновлению приложения 1.А к [Руководству по приборам и методам наблюдений](#) (ВМО-№ 8). Один из планов заключается в том, чтобы разработать всеобъемлющую систему, в рамках которой будет представлен общий обзор соответствующих факторов неопределенности, отсутствующих в текущем приложении, а также подробно зафиксировать требования к неопределенности измерений и привести их в соответствие с ККИ. Для «всеобъемлющей системы» необходимо найти подходящее место, которое позволит обеспечить беспрепятственный доступ и гибкое обслуживание. Ожидаемое решение может предполагать создание нового модуля в рамках ОСКАР, который будет посвящен потенциалу в области проведения наземных измерений. В рамках ОСКАР данный потенциал в области проведения измерений вполне может послужить вкладом в проводимый в рамках регулярного обзора потребностей Интегрированной глобальной системы наблюдений ВМО (ИГСНВ) анализ пробелов.

Решение 13 (ИНФОМ-3)

Руководящие принципы проведения взаимосравнений радиометров

Комиссия по наблюдениям, инфраструктуре и информационным системам,

ссылаясь на:

- 1) [резолюцию 13 \(ИК-XXXIV\)](#) «Разработка и сравнение радиометров»;
- 2) [резолюцию 32 \(ИС-76\)](#) «К смене радиационных эталонов»,

будучи проинформирована о работе Экспертной группы Постоянного комитета по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП) по радиационным эталонам, направленной на обеспечение сопоставимости и прозрачности процедуры, используемой при взаимосравнении радиометров, которая была включена в обновленное [Руководство по приборам и методам наблюдений](#) (ВМО-№ 8),

подтверждая важность точных и стабильных эталонов для измерений солнечной и земной радиации и роль ВМО в поддержании и распространении существующего Мирового радиометрического эталона,

признавая важность долгосрочного доступа к данным взаимосравнений радиометров, которые используются для обеспечения стабильности эталонов,

рекомендует Исполнительному совету обратиться к радиационным центрам, особенно к Мировому радиационному центру и региональным радиационным центрам, с просьбой следовать этим руководящим принципам при организации взаимосравнений радиометров;

порукает ПК-ИПП распространить эти руководящие принципы среди радиационных центров и разработчиков приборов и проконсультировать радиационные центры относительно их применения при предстоящих взаимосравнениях радиометров.

Обоснование решения: вопрос о включении руководящих принципов проведения взаимосравнений радиометров в главу 7 тома I *Руководства по приборам и методам наблюдений* (ВМО-№ 8) был рассмотрен в *резолюции 7 (ИНФКОМ-3)*. В нынешнем решении региональным радиационным центрам предлагается следовать им.

Решение 14 (ИНФКОМ-3)

Будущие взаимосравнения приборов

Комиссия по наблюдениям, инфраструктуре и информационным системам:

подчеркивает важность взаимосравнений приборов для оценки эффективности различных типов приборов и соответствующих методов наблюдений;

приветствует интерес, проявленный несколькими группами экспертов и Членами к проведению взаимосравнений приборов;

признает проблемы, связанные с ресурсами, необходимыми для организации глобальных взаимосравнений, а также материально-технические проблемы, связанные с межлабораторными и инструментальными взаимосравнениями;

отмечая необходимость повышения информированности Членов о новых решениях, позволяющих эффективно осуществлять наблюдения за уровнем воды и стоком рек,

соглашается с актуальностью проведения взаимосравнений, связанных с автоматическими метеорологическими станциями, приборами для измерения радиации, аэрологическими приборами, осадкомерами, не имеющими осадкоприемника, измерителями течения, алгоритмами измерений, межлабораторными взаимосравнениями и, возможно, другими темами в зависимости от наличия ресурсов;

напоминает, что Международное сравнение пиргелиометров и международное сравнение пиргеометров организуются Мировым радиационным центром не реже одного раза в пять лет для обеспечения стабильности Группы международных эталонов и Группы международных ИК-эталонов и для распространения соответствующих эталонов по всему миру; следующее взаимосравнение запланировано на 2025 год;

признает важность учета факторов, связанных с экологической устойчивостью, при проведении взаимосравнений;

предлагает Членам, представленным в Комиссии, особенно тем, на территории которых расположены ведущие центры измерений:

- 1) обменяться с Постоянным комитетом по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП) процедурами, связанными с испытанием автоматических метеорологических станций (АМС), в частности универсальных АМС и более экономичных АМС;

- 2) провести эксперименты, касающиеся применения Классификации размещения площадок для станций приземных наблюдений на суше, с тем чтобы по возможности получить количественную оценку воздействия препятствий на измерения, и опубликовать эти результаты либо предоставить их ПК-ИПП ввиду обновления данной схемы классификации;
- 3) обмениваться результатами экспериментов, проведенных с использованием осадкомеров, не имеющих осадкоприемника, и по возможности выразить заинтересованность в активном участии во взаимосравнении осадкомеров, не имеющих осадкоприемника (например, предоставить испытательный полигон и/или средства калибровки, внести вклад в определение объема работы и протокола взаимосравнения);
- 4) проводить взаимосравнения гидрометрических методов измерения уровня и расхода воды, включая инновационные, перспективные и недорогостоящие решения;
- 5) проводить взаимосравнения методов наблюдений за основными криосферными переменными;
- 6) публиковать результаты взаимосравнений приборов, проведенных на национальном уровне, в интересах других Членов, по возможности в виде [отчетов о приборах и методах наблюдений](#);
- 7) рассмотреть вопрос о проведении на своей территории будущих взаимосравнений приборов ВМО с учетом последствий этого решения для ресурсов своих служб;

порукает ПК-ИПП:

- 1) сотрудничать с потенциальными руководителями взаимосравнений в рассмотрении подробных планов / концептуальных записок по взаимосравнениям приборов, которые будут отвечать потребностям Членов и проводиться либо в качестве мероприятий ВМО, либо в качестве многосторонних мероприятий;
- 2) определять приоритетность взаимосравнений с учетом рабочей нагрузки ПК-ИПП и наличия ресурсов, приоритетов ВМО и зрелости предложений/планов, представленных на рассмотрение, а также их потенциального/ожидаемого воздействия;
- 3) обеспечить внедрение оптимальных механизмов, обеспечивающих равный доступ всех Членов ВМО к взаимосравнениям приборов и межлабораторным сличениям, организуемым ВМО;
- 4) разработать руководящие принципы для взаимосравнения универсальных АМС, которые впоследствии могли бы применяться Членами при проведении распределенного взаимосравнения универсальных АМС.

Более подробную информацию см. в документе INFCOM-3/INF. 8.2(6).

Обоснование решения: в [резолюции 32 \(ИС-76\)](#) подчеркивается важность взаимосравнения для планирования предполагаемых изменений радиационных эталонов. Взаимосравнения приборов ВМО оказывают значительное влияние на выбор приборов Членами и стимулируют новые разработки. Однако организация глобальных взаимосравнений сопряжена с определенными проблемами, поскольку для их проведения требуются ресурсы. Ввиду ограниченности имеющихся экспертных ресурсов и ресурсов Секретариата ПК-ИПП может одновременно осуществлять надзор лишь за несколькими глобальными взаимосравнениями. Следует поощрять проведение сравнений на национальном и многостороннем уровне, которые также представляют ценность.

Решение 15 (ИНФКОМ-3)

Последующие мероприятия в связи с взаимным сравнением аэрологических приборов 2022 года

Комиссия по наблюдениям, инфраструктуре и информационным системам,

с удовлетворением отмечая недавнюю публикацию отчета о Кампании ВМО по взаимному сравнению аэрологических приборов 2022 года ([Report of WMO's 2022 Upper-Air Instrument Intercomparison Campaign](#) ((IOM) Report No. 143)), а также публикацию программного кода, который использовался для анализа данных,

выражая глубокую признательность за значительный вклад, внесенный Германией и Швейцарией в совместное руководство проведением в 2022 году взаимного сравнения аэрологических приборов, в том числе за проведение анализа данных и подготовку отчета,

подчеркивает важнейшую роль аэрологических измерений для нескольких областей применения и важность знания качества этих измерений;

напоминая о том, что аэрологические измерения составляют значительную часть данных, передаваемых через Глобальную опорную сеть наблюдений (ГОСН),

предлагает производителям приборов выполнить рекомендации по совершенствованию систем аэрологических наблюдений, изложенные в отчете о взаимном сравнении (например, калибровка датчиков влажности, временная задержка регистрации влажности воздуха при низких температурах от $-40\text{ }^{\circ}\text{C}$ до $-85\text{ }^{\circ}\text{C}$), и продолжать усилия по снижению воздействия этих систем на окружающую среду;

предлагает Членам использовать отчет о взаимном сравнении, предупреждая при этом, что другие источники информации также имеют значение для выбора систем наблюдения, отвечающих их требованиям, и что системы, не участвовавшие во взаимном сравнении, также должны быть приняты во внимание;

настоятельно призывает Постоянный комитет по системам наблюдения за Землей и сетям мониторинга (ПК-СНСМ) обеспечить, чтобы требования Инструмента анализа и обзора возможностей систем наблюдения (ОСКАР) включали четкие ссылки на их обоснование и на то, как они были получены;

постановляет:

- 1) поручить Постоянному комитету по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП) обновить соответствующие главы [Руководства по приборам и методам наблюдений](#) (ВМО-№ 8), принимая во внимание результаты взаимного сравнения;
- 2) поручить ПК-ИПП и Постоянному комитету по управлению информацией и информационными технологиями (ПК-УИИТ) содействовать доступу к существующим кодам радиозондов (включая их документирование) и содействовать присвоению кодов новым разработанным радиозондовым системам;

признавая важность проведения регулярных взаимных сравнений аэрологических приборов для стимулирования инноваций и демонстрации эффективности новых систем,

принимая к сведению предложение Индии провести у себя следующее взаимное сравнение аэрологических приборов,

предлагает ведущим центрам измерений и Членам, представленным в Комиссии, в сотрудничестве с ИНФКОМ:

- 1) помочь в проверке корректности двоичной универсальной формы представления метеорологических данных (BUFR), генерируемых новыми радиозондовыми системами;
- 2) рассмотреть вопрос о проведении будущих взаимных сравнений аэрологических приборов, опираясь на опыт, полученный в ходе этого взаимного сравнения.

Обоснование решения: недавно был опубликован отчет о Кампании ВМО по взаимному сравнению аэрологических приборов 2022 года, в котором содержится ряд рекомендаций для ВМО, Членов и производителей.

Решение 16 (ИНФКОМ-2)

Проект решения о стандартизации сбора данных «первой мили»

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

- 1) подчеркнуть важность решения вопросов, связанных с отсутствием стандартизации в области сбора данных «первой мили» с наблюдательных платформ, как это отмечается в содержащемся в документе INFCOM-3/INF. 8.3(4) заявлении по итогам семинара, посвященного вопросам стандартизации в области сбора данных «первой мили» с автоматических наблюдательных станций и платформ;
- 2) поручить Постоянному комитету по управлению информацией и информационным технологиям (ПК-УИИТ) возглавить деятельность по стандартизации сбора данных «первой мили» во всех областях системы Земля объединив усилия с Постоянным комитетом по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ), Постоянным комитетом по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП), консультативными группами ИНФКОМ и Ассоциацией производителей гидрометеорологического и экологического оборудования (ПГМО);
- 3) поручить ПК-УИИТ представить ИНФКОМ-4 доклад о проделанной работе.

Более подробную информацию см. в документе INFCOM-3/INF. 8.3(4).

Обоснование решения: семинар по стандартизации в области сбора данных «первой мили» с автоматических наблюдательных станций и платформ состоялся 19—20 февраля 2024 года в Женеве и был посвящен решению вопросов, связанных с отсутствием стандартизации в области передачи данных с наблюдательных платформ на пункты сбора.

ВМО регулирует международный обмен данными наблюдений в реальном времени, с тем чтобы обеспечивать наличие данных наблюдений высокого качества для различных применений в области метеорологического и гидрологического прогнозирования, что позволяет центрам численного прогнозирования погоды (ЧПП), а также центрам

климатического и гидрологического прогнозирования производить надежную продукцию. Национальные метеорологические и гидрологические службы (НМГС) используют продукцию ЧПП для мониторинга и прогнозирования метеорологических и гидрологических условий, с тем чтобы обеспечивать выпуск прогнозов и предупреждений, необходимых для защиты жизни и имущества граждан от опасных природных явлений, прежде всего в рамках инициативы «Заблаговременные предупреждения для всех».

НМГС осуществляют эксплуатацию сетей, состоящих из различных систем наблюдений, с тем чтобы удовлетворять потребности в данных наблюдений для решения задач на национальном, региональном и международном уровне, а также в целях обмена данными на международном уровне в соответствии с Техническим регламентом ВМО. Данные поступают с наблюдательных платформ, подвергаются обработке и контролю качества, после чего используются на национальном уровне, а также становятся предметом международного обмена. ВМО не регулирует этот начальный этап сбора данных, предусматривающий их передачу с наблюдательных станций в системы сбора и обработки (сбор данных «первой мили»).

Отсутствие стандартизации в области сбора данных «первой мили» отрицательно сказывается на функциональной совместимости систем наблюдения и систем сбора данных, закупаемых и эксплуатируемых НМГС. Наблюдаемое во многих НМГС распространение централизованных аппаратных средств обработки данных в основном обусловлено существующим пробелом в стандартизации сбора данных «первой мили», в связи с которым НМГС вынуждены внедрять промежуточное программное обеспечение в целях унификации данных и решения проблем, связанных с отсутствием функциональной совместимости. В результате происходит формирование разного рода систем наблюдений и систем сбора и обработки данных, управлять которыми становится все сложнее. Это объясняется расширением и усложнением сетей наблюдений в связи с растущей необходимостью защиты жизни и имущества граждан от все более частых и опасных природных явлений, вызванных изменением климата.

ВМО призывает частный сектор к сотрудничеству в области стандартизации передачи данных «первой мили», с тем чтобы в этот трудный период, характеризующийся ростом обязательств и сокращением бюджета, оказать содействие деятельности НМГС по упрощению передачи данных между системами наблюдений и системами сбора и обработки данных путем стандартизации электросвязи, протоколов передачи и форматов данных.

Стандартизация передачи данных «первой мили» имеет решающее значение для реализации стратегии ВМО, основанной на системе Земля, и Единой политики ВМО в области данных, поскольку данные от сообществ партнеров, включая промышленность и научные исследования, необходимы для удовлетворения потребностей во всех областях системы Земля, а также для того, чтобы эти сообщества могли эффективно предоставлять свои данные.

Решение 17 (ИНФОМ-3)

Учреждение исследовательской группы по будущей инфраструктуре данных

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

- 1) вновь подтвердить, что Члены признают, что:

- a) взрывной рост объема данных и появление эмуляторов и других приложений искусственного интеллекта (ИИ) в действующей и будущей цепочке численного прогнозирования меняет парадигмы обработки и инфраструктуры данных, которые национальные метеорологические и гидрологические службы (НМГС) и спутниковые операторы рассматривают сейчас и в будущем;
 - b) стратегии «данные на месте» и приближенные вычисления данных (ПВД), доступ к вычислениям и функциональная совместимость, облачные решения и обработка «на лету» представляют собой новые технологические концепции, которые определяют будущий дизайн и работу систем, обеспечивающих интерфейс между производителями и пользователями данных; и
 - c) эти новые технологии и концепции являются основой для непрерывного развития Комплексной системы обработки и прогнозирования ВМО (КСОПВ) и Информационной системы ВМО (ИСВ);
- 2) учредить Исследовательскую группу по будущей инфраструктуре данных (ИГ-БИД) с кругом ведения, приведенным в дополнении к [резолюции 3 \(ИНФОМ-3\)](#).

Обоснование решения: в [резолюции 25 \(Кг-19\)](#) «Технический регламент Информационной системы ВМО 2.0» содержалось поручение ИНФОМ изучить технологические достижения, касающиеся подходов «данные на месте» и их применения в области обмена данными в рамках сообщества ВМО, и разработать рекомендации в отношении будущего развития ИСВ и КСОПВ, включая механизмы привлечения к процессу развития поставщиков облачной инфраструктуры.

Дополнение к решению 17 (ИНФОМ-3)

[Утвержденный круг ведения включен в дополнение к [резолюции 3 \(ИНФОМ-3\)](#)]

Решение 18 (ИНФОМ-3)

Обновление Руководства по Комплексной системе обработки данных и прогнозирования ВМО (ВМО-№ 305)

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

- 1) отметить, что переменные вихря тропической депрессии/циклона введены в качестве обязательной и рекомендуемой продукции назначенных центров Комплексной системы обработки и прогнозирования ВМО (КСОПВ), осуществляющих глобальное детерминистское и ансамблевое численное прогнозирование погоды (ЧПП);
- 2) включить руководство по получению переменных вихря тропической депрессии/циклона в [Руководство по КСОПВ](#) (ВМО-№ 305), как указано в дополнении к настоящему решению.

См. дополнение к настоящему решению.

Обоснование решения:

резолюция 1 (СЕРКОМ-2) «Обновления *Наставления по Глобальной системе обработки данных и прогнозирования* (ВМО-№ 485), предложенные постоянными комитетами СЕРКОМ», в которой ИНФКОМ рекомендуется обновить и классифицировать траектории прохождения тропических циклонов, получаемые в качестве выходной продукции детерминистских и ансамблевых моделей численного прогнозирования погоды (ЧПП) как глобальных, так и ограниченных масштабов, как обязательные данные;

рекомендация 9 (ИНФКОМ-3) «Поправки к *Наставлению по Глобальной системе обработки данных и прогнозирования ВМО* (ВМО-№ 485) для прогнозирования погоды», в котором содержится предложение включить в Наставление новый перечень переменных вихря тропической депрессии/циклона в качестве обязательной и рекомендуемой продукции назначенных центров КСОПВ для глобального детерминистского и ансамблевого ЧПП.

Дополнение к решению 18 (ИНФКОМ-3)

Руководство по получению переменных вихря тропической депрессии/циклона

2.3.1.1 Глобальный детерминистский численный прогноз погоды

2.3.1.1.1 Общее резюме деятельности Регионального специализированного метеорологического центра

За период примерно после 2000 года технология численного прогнозирования погоды (ЧПП) значительно улучшилась, а данные и продукция ЧПП существенно важны для самых разных видов деятельности. Для поддержания работоспособности глобального детерминистского ЧПП необходимы значительные ресурсы. В связи с этим на шестьдесят девятой сессии Исполнительного совета ВМО (ИС-69) в 2017 году (когда было всесторонне пересмотрено *Наставление по КСОПВ*) глобальное детерминистское ЧПП было отнесено к деятельности, осуществляемой РСМЦ в рамках КСОПВ, с целью обеспечения доступности данных и продукции глобального детерминистского ЧПП гарантированного качества для всех Членов ВМО.

Примечание: до ИС-69 (2017 г.) некоторые глобальные данные и продукция ЧПП предоставлялись ММЦ и несколькими РСМЦ с географической специализацией, но их подходы не были согласованы.

РСМЦ, осуществляющие глобальное детерминистское численное прогнозирование погоды, отвечают за предоставление глобальных анализов трехмерной структуры атмосферы и глобальных прогностических полей основных и производных параметров атмосферы, полученных с помощью их собственных систем глобального детерминистского численного прогнозирования погоды, наряду с соответствующей и стандартизированной верификацией статистических данных.

i) Назначенные центры и методы работы

Список назначенных РСМЦ для осуществления глобального детерминистского численного прогнозирования погоды приведен в *Наставлении по КСОПВ*, часть III.

Каждый из этих РСМЦ предоставляет данные и продукцию с глобальным охватом.

Руководство по получению переменных вихря тропической депрессии/циклона представлено в Приложении 2.3. Координация между РСМЦ не требуется. РСМЦ должны направлять статистику верификации в Ведущий центр верификации детерминистских численных прогнозов погоды (ВЦ-ВДЧ).

ii) Как национальные метеорологические центры могут извлечь пользу и/или внести вклад в работу региональных специализированных метеорологических центров

НМЦ могут получить доступ к данным и продукции, предоставляемым РСМЦ для глобального детерминистского численного прогнозирования погоды через ИСВ. Доступ к метаданным ИСВ, связанным с каждым файлом данных и продукции, можно получить [здесь](#), где из перечня видов деятельности пользователи могут выбрать «Глобальный детерминистский численный прогноз погоды».

НМЦ предлагается вносить вклад в деятельность РСМЦ следующим образом, не ограничиваясь этим списком: а) проведение объективной верификации и предоставление отзывов об эффективности работы соответствующих моделей, используемых в их странах; б) проведение исследований конкретных явлений и обмен такой информацией с РСМЦ; в) сотрудничество с РСМЦ по конкретным разработкам моделей на основе результатов верификации; и д) предоставление дополнительных данных наблюдений для ассимиляции таких данных в моделях.

2.3.1.3 Глобальный ансамблевый численный прогноз погоды

2.3.1.3.1 Общее резюме деятельности Регионального специализированного метеорологического центра

Ансамбль ЧПП, в котором численная модель прогоняется много раз с несколько разными начальными условиями, дает гораздо более полную картину прогноза, чем детерминистское ЧПП, включая оценки неопределенности и вероятности возможных экстремальных явлений или явлений со значительными последствиями. Для поддержания работоспособности глобального ансамблевого ЧПП требуются значительные ресурсы. В связи с этим на шестьдесят девятой сессии Исполнительного совета ВМО (ИС-69) в 2017 году глобальное ансамблевое ЧПП было отнесено к деятельности, осуществляемой РСМЦ в рамках КСОПВ, с целью обеспечения доступности данных и продукции глобального детерминистского ЧПП гарантированного качества для всех Членов ВМО.

РСМЦ для проведения глобального ансамблевого численного прогнозирования погоды отвечают за предоставление глобальных прогностических полей агрегированных статистических данных ансамбля для отобранных атмосферных параметров, сгенерированных их собственными системами глобального ансамбля ЧПП, наряду с соответствующей и стандартизированной статистикой верификации. Виды продукции усредненных значений и их разброса по ансамблю дают краткое представление о предсказуемых масштабах эволюции синоптической ситуации, в то время как разброс по ансамблю указывает на области большей уверенности или значительной неопределенности. Вероятностные значения ансамбля обеспечивают поддающиеся оценке предупреждения о рисках суровых или потенциально опасных явлениях погоды со значительными последствиями.

i) Назначенные центры и методы работы

Список назначенных РСМЦ для осуществления глобального ансамблевого численного прогнозирования погоды приведен в *Наставлении по КСОПВ*, часть III.

Каждый из этих РСМЦ предоставляет данные и продукцию с глобальным охватом.

[Руководство по получению переменных вихря тропической депрессии/циклона представлено в Приложении 2.3.](#) Координация между РСМЦ не требуется. РСМЦ должны направлять результаты верификации в Ведущий центр верификации детерминистских численных прогнозов.

ii) Как национальные метеорологические центры могут извлечь пользу и/или внести вклад в работу региональных специализированных метеорологических центров

НМЦ могут получить доступ к данным и продукции, предоставляемым РСМЦ для глобального ансамблевого численного прогнозирования погоды через ИСВ. Доступ к метаданным ИСВ, связанным с каждым файлом данных и продукции, можно получить на [веб-портале КСОПВ](#),

выбрав из перечня видов деятельности «Глобальный ансамблевый численный прогноз погоды».

НМЦ предлагается вносить вклад в деятельность РСМЦ следующим образом, не ограничиваясь этим списком: а) проведение объективной верификации и предоставление отзывов об эффективности работы соответствующих ансамблей, используемых в их странах; б) проведение исследований конкретных явлений и обмен такой информацией с РСМЦ; в) сотрудничество с РСМЦ по конкретным разработкам моделей на основе результатов верификации; и д) предоставление дополнительных данных наблюдений для ассимиляции таких данных в моделях.

ПРИЛОЖЕНИЕ 2.3. РУКОВОДСТВО ПО ПОЛУЧЕНИЮ ПЕРЕМЕННЫХ ВИХРЯ ТРОПИЧЕСКОЙ ДЕПРЕССИИ/ЦИКЛОНА

Для содействия предоставлению продукции переменных вихря тропической депрессии/циклона (далее — продукция вихря ТЦ), полученной с использованием одинаковых методов, РСМЦ для глобальных детерминистских и ансамблевых ЧПП рекомендуется принять следующее руководство:

А. Идентификация тропических циклонов в сетках ЧПП

Данные о параметрах вихря обрабатываются после получения непосредственной выходной продукции моделей и, как ожидается, включают вихри тропических циклонов, которые присутствуют на момент анализа или формируются в прогнозируемом временном диапазоне. В данном контексте тропический циклон представляет собой общий термин для обозначения нефронтальной системы низкого давления синоптического масштаба, которая имеет циклоническую циркуляцию ветра, и не относится к ее интенсивности или силе. К региональным примерам тропических циклонов относятся тропическая область низкого давления, тропическая депрессия, тропический шторм, тропический циклон, циклонический шторм, тайфун и ураган. Наличие и положение тропического циклона в данных в узлах сетки ЧПП представляет собой точку. Временной ряд точек образует траекторию.

При применении метода для определения наличия тропического циклона в сетках ЧПП необходимо стремиться отфильтровать неглубокие тепловые/термические депрессии и неглубокие слабые циркуляции. Эффективным в этом плане оказался инструмент отслеживания ЕЦСПП, который включает в себя проверку вихревого движения 850 гПа и наличие теплого ядра.

При использовании вихревого движения 850 гПа следует учитывать разрешение сетки, которое влияет на расчетные значения. Чтобы избежать выявления мелкомасштабных особенностей, расчеты вихревого движения можно проводить по крупной сетке или с применением пространственного среднего.

В. Идентификаторы тропических циклонов в формате BUFR

В формате файла BUFR для данных о параметрах вихря тропического циклона различные траектории циклонов идентифицируются с помощью полей «stormIdentifier» и «longStormName». Указатель шторма представляет собой строку из четырех символов, где первые три — это цифры, а последний — заглавная буква. Полное название шторма — это строка.

Эти поля следует использовать в соответствии со следующими условными обозначениями:

- Если есть местоположение на основе анализа от РСМЦ по прогнозированию тропических циклонов или Центра¹ предупреждений о тропических циклонах (ЦПТЦ), которое содержит указатель шторма BMO, то stormIdentifier должен быть этим указателем (например, 02W становится 002W), а longStormName — названием. РСМЦ имеют следующие бассейны W, E, C, L, A, B, S, P, F, U, O, T:
 - W — северо-западная часть Тихого океана
 - E — северо-восточная часть Тихого океана до 140° в. д.
 - C — северо-восточная часть Тихого океана в пределах 140°–180° в. д.
 - L — северная часть Атлантического океана, включая Карибское море и Мексиканский залив
 - A — северная часть Аравийского моря
 - B — Бенгальский залив
 - S — южная часть Индийского океана
 - P — южная часть Тихого океана
 - F — РСМЦ района Нади в южной части Тихого океана
 - U — Австралия
 - O — Южно-Китайское море
 - T — Восточно-Китайское море
- Если РСМЦ по прогнозированию тропических циклонов или ЦПТЦ не предоставляют местоположение на основе анализа, но есть местоположение на основе анализа от Объединенного центра предупреждений о тайфунах (ОЦПТ) с обозначением области исследования или указателя шторма (например, 93P.INVEST или 09P.NINE) и учреждение отслеживания решает включить эти местоположения на основе анализа, то указатель шторма должен быть номером (например, 093P или 009P), а longStormName должен быть частью с названием указателя (например, INVEST или NINE). Номера областей исследования находятся в диапазоне от 90 до 99. Буква в номере области исследования указывает на бассейн. Бассейны ОЦПТ — это L, E, C, W, A, B, S, P:
 - L — Атлантический океан
 - E — восточная часть Тихого океана
 - C — центральная часть Тихого океана
 - W — западная часть Тихого океана
 - A — Аравийское море
 - B — Бенгальский залив
 - S — южная часть Индийского океана (20° в. д. — 135° в. д.)
 - P — южная часть Тихого океана (135° в. д. — 120° з. д.)
- Если местоположения на основе анализа от РСМЦ по прогнозированию тропических циклонов, ЦПТЦ или ОЦПТ нет, то указатель шторма должен быть числом в диапазоне от 100 до 999, а буква — обозначать бассейн (например, 101A). Полное название longStormName должно быть таким же, как и stormIdentifier, или null. Для определения бассейна следует исходить из положения первой точки траектории. В таблице ниже приводится описание бассейнов.

Название бассейна	Буква	Область
Северная часть Индийского океана	A	От 20° в. д. до 78° в. д., к северу от экватора
Северная часть Индийского океана	B	От 78° в. д. до 100° в. д., к северу от экватора
Северо-западная часть Тихого океана	W	От 100° в. д. до 180° в. д., к северу от экватора

¹ ИНФОМ совместно с СЕРКОМ будут работать над пересмотром руководства, поддерживающего эти резервные меры.

Северо-центральная часть Тихого океана	C	От 180° в. д. до 220° в. д., к северу от экватора
Северо-восточная часть Тихого океана	E	220° в. д. — линия перехода от северной части Тихого океана к северной части Атлантического океана, к северу от экватора
Северная Атлантика	L	От линии перехода от северной части Тихого океана к северной части Атлантического океана до 20° в. д., к северу от экватора
Южная часть Индийского океана	S	От 20° в. д. до 90° в. д., к югу от экватора
Австралия	U	От 90° в. д. до 160° в. д., к югу от экватора
Южная часть Тихого океана	F	От 160° в. д. до 240° в. д., к югу от экватора

Линия перехода от северной части Тихого океана к северной части Атлантического океана определяется как (90,0 с. ш., 260,0 в. д.) — (20,0 с. ш., 260,0 в. д.) — (13,0 с. ш., 275,0 в. д.) — (9,0 с. ш., 277,0 в. д.) — (8,5 с. ш., 279,0 в. д.) — (9,0 с. ш., 281,5 в. д.) — (5,0 с. ш., 285 в. д.) — (0,0 с. ш., 285,0 в. д.).

C. Вычисление параметров

- i. Местоположение центра вихря
Это должно быть положение минимального среднего давления на уровне моря, рассчитанное по сетке с точностью до 0,1 градуса.
- ii. Максимальная устойчивая скорость ветра на высоте 10 м
Метод определения этого параметра для заданного времени заключается в нахождении максимальной скорости ветра в сетке для этого времени в пределах 500 км от центра вихря.

Устойчивая скорость ветра является непосредственным выходным результатом модели и представляет собой значение, усредненное за период и по размеру ячейки сетки. Это означает, что период усреднения ветра не может составлять точно 1 или 10 минут. Значение максимального устойчивого ветра не является значением порыва ветра.

- iii. Местоположение максимальной устойчивой скорости ветра на высоте 10 м
Этот параметр представляет собой широту и долготу максимальной устойчивой скорости ветра на высоте 10 м, найденной с помощью описанного выше метода.
- iv. Минимальное среднее давление на уровне моря
Минимальное среднее давление на уровне моря в ячейке сетки (или ближайшей ячейке сетки), по которой было определено местоположение центра вихря. Значение должно быть фактическим значением сетки, а не рассчитанным с помощью экстраполяции.
- v. Радиусы ветра
Для каждого квадранта — радиус близкого к максимальному значению, но не включая переходные или изолированные характеристики, скорости ветра, превышающей пороговое значение или равной ему, входящей в состав средней циркуляции. Квадранты по часовой стрелке: с севера на восток, с востока на юг, с юга на запад, с запада на север.

В алгоритмах, используемых при обработке параметров ветра радиолокатором с синтезированной апертурой (РСА), и в последней версии инструмента отслеживания

Лаборатории геофизической гидродинамики (ЛГГД) применяется 95-й процентиль для определения радиуса вблизи максимума.

vi. Средний ведущий ветер

Задача заключается в том, чтобы на основе этих ведущих ветров иметь возможность рассчитать сдвиг. Рекомендуемый метод заключается в том, чтобы рассчитать зональную (u) и меридиональную (v) скорости на каждом уровне давления как среднее значение по ячейкам сетки в пределах 500 км от центра низкого уровня после применения метода удаления вихря.

Можно использовать и другие методы. Метод должен быть описан в характеристиках продукции (см. Приложения 2.2.2 и 2.2.6 Наставления по КСОПВ (ВМО-№ 485)). Различные значения расстояния и методы удаления вихря дают разные значения ведущего ветра и, следовательно, разные значения сдвига. Если в руководствах из разных источников используются разные значения или методы, то прямое сравнение значений между такими руководствами может ввести в заблуждение.

Изложенный ниже метод основан на методе расчета вертикального сдвига ветра SHIPS, который является более современной версией метода, описанного в Knaff et al. (2009), согласно цитате в Kaplan et al. (2010).

1. Удалите симметричный вихрь относительно расположения вихря в модели.
 - a. Найдите положение вихря на высоте 850 гПа с максимальной симметричной тангенциальной составляющей ветра, усредненной по радиусу от 0 до 500 км. Задайте начальное приближение положения поверхностного вихря.
 - b. Вычитите усредненные по азимуту тангенциальную и радиальную составляющие ветра из общего поля ветра на уровнях 850 гПа, 500 гПа и 200 гПа, используя положение вихря на уровне 850 гПа.
 - c. Вычитите усредненный ветер до радиуса, где азимутальная усредненная тангенциальная составляющая ветра достигнет не менее 2 м/с. Этот радиус почти всегда намного больше на низких уровнях, чем на верхних, и иногда при более низких значениях давления ничего не удаляется.
2. Рассчитайте усредненное по площади от 0 до 500 км значение составляющих u и v на уровнях 850 гПа, 500 гПа и 200 гПа с центром на месте приземного вихря.

D. Ссылки

- Kaplan, J., M. DeMaria, and J. A. Knaff, 2010: A Revised Tropical Cyclone Rapid Intensification Index for the Atlantic and Eastern North Pacific Basins. *Wea. Forecasting*, 25, 220–241, <https://doi.org/10.1175/2009WAF2222280.1>.
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Решение 19 (ИНФОМ-3)

Демонстрация регулярного обзора потребностей Комплексной системы обработки и прогнозирования ВМО

Комиссия по наблюдениям, инфраструктуре и информационным системам:

рассмотрев регулярный обзор потребностей Комплексной системы обработки и прогнозирования ВМО (РОП КСОПВ) в качестве систематического и прозрачного процесса для поддержки проектирования архитектуры и развития КСОПВ на основе изменяющихся потребностей пользователей и постоянного совершенствования анализа (включая реанализ) и прогнозов, как это предлагается в документе INFCOM-3/ INF. 8.4(4),

постановляет поручить Постоянному комитету по обработке данных для прикладных методов моделирования и прогнозирования системы Земля (ПК-МПСЗ):

- 1) провести демонстрацию РОП КСОПВ, сотрудничая с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ);
- 2) доложить о результатах демонстрации, включая доработку РОП КСОПВ, на ИНФКОМ-4 (2026 г.);

предлагает СЕРКОМ, особенно Постоянному комитету по обслуживанию в области снижения риска бедствий и обслуживанию населения (ПК-СРБ) и Постоянному комитету по климатическому обслуживанию (ПК-КЛИ), присоединиться к демонстрации.

Дополнительную информацию см. в INFCOM-3/INF. 8.4(4).

Обоснование решения: разработка и внедрение РОП определены в качестве одной из ключевых приоритетных областей в дополнении к [резолюции 58 \(Кг-18\)](#) «Структура сотрудничества будущей интегрированной бесшовной глобальной системы обработки данных и прогнозирования». Разработка РОП КСОПВ также рассматривается как одно из приоритетных действий для понимания потребностей пользователей к продукции КСОПВ для инициативы «Заблаговременные предупреждения для всех», перечисленных в [решении 6 \(ИНФКОМ-3\)](#).

Решение 20 (ИНФКОМ-3)

Дорожная карта по интеграции информации и продукции по криосфере в Комплексную систему обработки и прогнозирования ВМО (КСОПВ)

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет утвердить дорожную карту по интеграции информации и продукции по криосфере в КСОПВ, представленную в дополнении к настоящему решению.

Более подробную информацию см. в документе INFCOM-3/INF. 5.

Обоснование решения:

Дорожная карта включает в себя действия, предусмотренные следующими резолюциями:

резолюция 58 (Кг-18)	«Структура сотрудничества будущей интегрированной бесшовной глобальной системы обработки данных и прогнозирования»;
резолюция 2 (Кг-19)	«Стратегический план ВМО на 2024—2027 годы»;

резолюция 4 (КГ-19)	«Инициатива Организации Объединенных Наций „Заблаговременные предупреждения для всех“»;
резолюция 6 (КГ-19)	«Приоритетные задачи в свете глобального и регионального воздействия изменений в криосфере»;
резолюция 18 (ИС-73)	«Переходный период и предварительный оперативный план Глобальной службы криосферы (ГСК)»;
резолюция 4 (ИНФКОМ-2)	«Устранение пробелов в интеграции криосферы в подход ВМО на основе системы Земля»;
рекомендация 9 (ИНФКОМ-3)	«Поправки к <i>Наставлению по Комплексной системе обработки и прогнозирования ВМО</i> (ВМО-№ 485)».

Дорожная карта была разработана в ходе консультаций, как это зафиксировано в документе:

- 1) Отчет Совместного семинара по интеграции криосферы в Комплексную систему обработки и прогнозирования ВМО (КСОПВ) Консультативной группы — Глобальная служба криосферы (КГ-ГСК) и Постоянного комитета по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля (ПК-МПСЗ), 6—8 марта 2023 года, Осло (Норвегия);
- 2) Отчет второго совещания КГ-ГСК, 27—29 февраля 2024 года, Анкоридж, Аляска (США);
- 3) Отчет тринадцатого совещания Группы экспертов Исполнительного совета по полярным и высокогорным наблюдениям, исследовательской деятельности и обслуживанию (ПВНИДО-2024), 13—15 февраля 2024 года, Осло (Норвегия);
- 4) Отчет Семинара РА II по региональным аспектам Интегрированной глобальной системы наблюдений ВМО (ИГСНВ), 25—29 ноября 2023 года, Пекин (Китай).

Дополнение к решению 20 (ИНФКОМ-3)

Дорожная карта по интеграции информации и продукции по криосфере в Комплексную систему обработки и прогнозирования ВМО

1. Справочная информация

В резолюции 6 (КГ-19) «Приоритетные задачи в свете глобального и регионального воздействия изменений в криосфере» согласованы пять приоритетных задач для решения проблем глобального и регионального воздействия изменений в криосфере, чтобы обеспечить устойчивую и справедливую поддержку Членам в понимании глобального и регионального воздействия необратимых изменений в криосфере, их последующих последствий и повышенного риска бедствий, реагировании на них, смягчении их последствий и адаптации к ним. Комплексная система обработки и прогнозирования ВМО (КСОПВ) является эффективным механизмом для удовлетворения возникающих потребностей в информации о криосфере благодаря постоянному вкладу центров КСОПВ на глобальном и региональном уровнях.

Настоящая дорожная карта по интеграции продукции по криосфере в КСОПВ была разработана в ходе консультаций между Консультативной группой по Глобальной службе криосферы (КГ-ГСК) и Постоянным комитетом по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля (ПК-МПСЗ), что отражено в отчете совместного семинара, проведенного 6—8 марта 2023 года в Осло, Норвегия, и в

последующей работе КГ-ГСК. Дорожная карта направлена на удовлетворение потребностей в информации, определенных в резолюции 6 (КГ-19).

Поскольку многие из потенциальных видов продукции все еще находятся в области исследований, данная дорожная карта включает в себя рекомендации высокого уровня для пилотных проектов в соответствии со Структурой сотрудничества для бесшовной глобальной системы обработки данных и прогнозирования ([резолюция 58 \(КГ-18\)](#)).

Практическая реализация этой дорожной карты является совместной ответственностью КГ-ГСК и ПК-МПСЗ и потребует тесного взаимодействия с партнерами и другими программами.

Как только эти виды продукции станут доступными, они будут распространяться в качестве основных или настоятельно рекомендуемых, в том числе через сеть арктических региональных климатических центров (арктическая сеть РКЦ), сеть региональных климатических центров третьего полюса (сеть РКЦТП), будущую сеть антарктических региональных климатических центров (антарктическая сеть РКЦ) и другие механизмы.

2. Основные этапы деятельности

2.1 Включение в Наставление по КСОПВ различных видов продукции по криосфере, имеющих в распоряжении глобальных и региональных центров подготовки прогнозов

Следующие оперативные виды продукции были рекомендованы и включены в поправки к [Наставлению по Комплексной системе обработки и прогнозирования ВМО](#) (ВМО-№ 485), как указано в [рекомендации 9 \(ИНФКОМ-3\)](#):

- основные виды продукции: количество осадков в виде снега и водный эквивалент снежного покрова (также известный как водный эквивалент снега (ВЭС)) от глобальных центров подготовки субсезонных прогнозов и долгосрочных прогнозов (ГЦП-ССП и ГЦП-ДП);
- рекомендуемые виды продукции: количество осадков в виде снега, высота снежного покрова и ВЭС от региональных специализированных метеорологических центров для численного прогнозирования погоды (ЧПП) по ограниченному району (региональные специализированные метеорологические центры (РСМЦ) по ЧПП по ограниченному району) для тех регионов, где ожидается выпадение осадков в виде снега;
- рекомендуемые виды продукции: концентрация морского льда от ГЦП-ССП и ГЦП-ДП.

Были рекомендованы следующие дополнительные виды деятельности:

- проверка имеющихся на текущий момент данных о концентрации морского льда потенциально в сотрудничестве с Совместной рабочей группой по исследованиям в области проверки оправдываемости прогнозов (СРГИПОП) Всемирной программы метеорологических исследований (ВПМИ);
- оценка целесообразности использования настоятельно рекомендуемых видов продукции, как указано выше, в качестве основных видов продукции;
- оценка жизнеспособности рекомендуемых видов продукции краткосрочного прогнозирования морского льда (например, региональный даунскейлинг выходной продукции глобальных моделей), уже внедренных некоторыми региональными центрами моделирования климата (например, Норвегия и т. д.);
- оценка целесообразности использования температуры снега и температуры морского льда в качестве рекомендуемых или основных видов продукции.

Дальнейшие изменения и поправки к Наставлению по КСОПВ будут готовиться по мере необходимости.

2.2 Суточная выходная продукция сезонных моделей в поддержку обнаружения экстремальных явлений

Целесообразность производства и распространения ежесуточной выходной продукции сезонных моделей для обнаружения экстремальных явлений будет рассмотрена соответствующими группами экспертов ПК-МПСЗ, и могут быть даны рекомендации по их формализации. В настоящее время такие виды продукции доступны для Программы «Коперник» и Ведущего центра ВМО для долгосрочного прогнозирования на базе мультимодельных ансамблей (<https://www.wmolc.org/>), а также для некоторых ГЦП-ДП.

Ожидается представление к ИНФКОМ-4.

2.3 Обзор других доступных видов продукции по криосфере или имеющих отношение к характеристике изменений в криосфере

КГ-ГСК и ПК-МПСЗ организуют проведение обзора других видов продукции, которые могут быть уже доступными в назначенных центрах КСОПВ (глобальных и региональных) по криосфере или которые имеют отношение к характеристике изменений в криосфере (например, связанные с предсказуемостью опасных явлений в криосфере, таких как экстремальные осадки или повышение температуры, ведущее к увеличению рисков паводков в результате прорыва ледниковых озер и т. д.).

Этот обзор будет адресован также и к не назначенным центрам моделирования системы Земля.

Ожидается, что результаты обзора приведут к выработке рекомендаций по

1) возможностям рассмотрения новых видов продукции для КСОПВ, 2) заинтересованности в получении статуса центров КСОПВ, 3) улучшению верификации выявленных видов продукции и 4) потенциальным взаимным сравнениям отдельных видов продукции из сопряженных моделей и прикладных программ постпроцессинга, например, для оценки качества осадков в виде снега.

Результаты и рекомендации этого обзора будут собраны в отчете для ИНФКОМ-4.

2.4 Назначение РСМЦ по ЧПП по ограниченному району для полярных регионов

Норвежский метеорологический институт выразил заинтересованность в его назначении в качестве РСМЦ по краткосрочному прогнозированию по ограниченному району для Арктики в соответствии с требованиями, изложенными в Наставлении по КСОПВ (ВМО-№ 485), с упором на виды продукции, связанные со снегом и морским льдом.

Крайний срок подачи заявки для назначения — ИНФКОМ-4.

Другим учреждениям, использующим сходные прогностические модели, предлагается рассмотреть возможность такого назначения.

2.5 Предложения по потенциальным пилотным проектам КСОПВ по криосфере

В рамках подхода на основе системы Земля к обработке данных и прогнозированию и в соответствии со Структурой сотрудничества для бесшовной глобальной системы обработки данных и прогнозирования (резолюция 58 (Кг-18)) пилотные проекты КСОПВ

рассматриваются как практический механизм для изучения дальнейшего развития и содействия реализации для удовлетворения возникающих потребностей, включая потребности в информации об изменениях в криосфере и их последствиях.

КГ-ГСК в сотрудничестве со своими партнерами подготовит рекомендации для ПК-МПСЗ по пилотным проектам для удовлетворения возникающих потребностей. Их реализация будет осуществляться на основе решений ПК-МПСЗ.

В рамках всех проектов будут разработаны рекомендации по потенциалу новых видов продукции КСОПВ и/или новых типов центров, а также по дополнительной работе, необходимой для их практической реализации.

2.5.1 Гидрологическая продукция холодных регионов

КГ-ГСК будет содействовать разработке концепции пилотного проекта КСОПВ по гидрологии холодных регионов.

Крайний срок представления предложения: конец 2024 года.

Концепция будет учитывать:

- готовые гидрологические модели панарктических и/или холодных регионов, доступные сегодня в области научных исследований, а также выходную продукцию центров КСОПВ;
- интеграцию данных о снеге, ледниках, многолетней мерзлоте и крупных ледяных массивах в условиях редкой сети данных наблюдений;
- разработку рекомендаций для потенциальных взаимных сравнений;
- обратную связь с оперативными центрами подготовки прогнозов.

В более долгосрочной перспективе может быть рассмотрена возможность оценки стока в океан и его представления в существующих панарктических гидрологических моделях в связи с оценкой неопределенностей в моделировании таяния ледяного покрова и повышения уровня моря.

2.5.2 Оценка выходной продукции моделей толщины морского льда

КГ-ГСК будет содействовать разработке концепции пилотного проекта по оценке различных видов продукции по толщине морского льда (ТМЛ) из глобальных и региональных моделей и их целесообразности в качестве основных или настоятельно рекомендуемых видов продукции в рамках КСОПВ.

Крайний срок представления предложения: конец 2024 года.

Концепция будет включать различные виды продукции по ТМЛ из центров КСОПВ и оценку ассимиляции доступных видов продукции по ТМЛ со спутников.

Проект направлен на интеграцию результатов Полярного прогностического проекта и продукции по толщине морского льда в рамках проекта iNter-comparison eXerciSe, [SIN'XS](#); по его результатам будут разработаны рекомендации по системам наблюдений за ТМЛ в поддержку проверки и инициализации моделей.

2.5.3 *Продукция мониторинга и прогнозирования баланса поверхностной массы ледового щита*

В связи с необходимостью более тесной международной координации в области разработки продукции мониторинга и прогнозирования баланса поверхностной массы ледового щита КГ-ГСК будет координировать разработку концепции потенциального пилотного проекта КСОПВ по балансу поверхностной массы ледового щита (для Антарктики, Гренландии) в консультации с соответствующими сообществами.

Крайний срок представления предложения: конец 2025 года.

В рамках проекта будут изучаться устойчивость, последовательность и стандартизация информации о таянии ледового щита и его вкладе в повышение уровня моря, а также о связи между этим и воздействиями на прибрежные районы и малые острова. Хотя модели баланса поверхностной массы ледового щита для климатических временных масштабов были приняты сообществом Всемирной программы исследований климата (ВПИК), ни одна из них не работает, за исключением моделей, разработанных Датским метеорологическим институтом (ДМИ).

КГ-ГСК проведет консультации с соответствующими сообществами, работающими в этой области, с Группой экспертов Исполнительного совета ВМО по полярным и высокогорным наблюдениям, исследовательской деятельности и обслуживанию (ГЭИС-ПВНИДО), Советом по исследованиям и его программами (ВПИК, ВПМИ), Международной ассоциацией наук о криосфере (МАНК) и ее отделением по ледовым щитам, Научным комитетом по антарктическим исследованиям (СКАР), Членами и другими партнерами, а также рассмотрит:

- i) существующие виды продукции и потенциальные возможности для обмена данными с оперативными центрами;
- ii) наличие продукции уровня повторного анализа для баланса поверхностной массы и характеристики ледовых щитов на схемах поверхности.

Центры КСОПВ будут приглашены к участию с учетом их интереса к разработке глобальных моделей ледовых щитов. Арктическая сеть РКЦ и будущая антарктическая сеть РКЦ будут играть решающую роль в распространении этих видов продукции.

2.5.4 *Опасные явления, связанные с криосферой*

Международное сообщество все больше обеспокоено возникновением опасных явлений, связанных с криосферой. Инвентаризация этих опасных явлений и согласованность их мониторинга и представления данных отстают от большинства других видов опасных явлений. Существующие возможности прогнозирования в основном относятся к области исследований и имеют ограниченную координацию.

Концепция потенциального пилотного проекта КСОПВ будет разработана КГ-ГСК и программой «Окружающая среда третьего полюса» (ТРЕ) для определения компонентов, необходимых для устойчивого подхода в поддержку развития систем заблаговременных предупреждений. Другими важнейшими заинтересованными сторонами являются ГЭИС-ПВНИДО, МАНК, Международная ассоциация по изучению вечной мерзлоты (ИПА), Совет по исследованиям и Комиссия по обслуживанию (СЕРКОМ) через ее постоянные комитеты.

Крайний срок представления предложения: конец 2024 года.

Предложение будет включать в себя следующие основные компоненты:

- синтез категорий опасных явлений, связанных с криосферой, их характеристики и мониторинг, потребности и проблемы прогнозирования;

- инвентаризация существующих и потенциальных видов продукции из центров КСОПВ;
- передовые практики борьбы с наводнениями, вызванными прорывами ледниковых озер (GLOF), например инвентаризация ледниковых озер, картирование и оценка рисков, а также потребности и пробелы в области мониторинга и прогнозирования;
- рекомендации по пилотным проектам, потенциально через сеть РКЦТП;
- рекомендации по надлежащему представлению в Каталоге опасных явлений погоды, воды, климата и космической погоды (СНЕ), разработанном ВМО и Управлением Организации Объединенных Наций по снижению риска бедствий.

2.5.5 Экспериментальные виды продукции для многолетней мерзлоты

КГ-ГСК будет координировать разработку концепции потенциального пилотного проекта КСОПВ по видам продукции для многолетней мерзлоты в консультации с Советом по исследованиям, Арктической сетью РКЦ, ИПА, ГСНК и др.

Крайний срок представления предложения: конец 2025 года.

Официальное включение в КСОПВ различных видов продукции мониторинга многолетней мерзлоты стало бы значительным стимулом для обмена данными между многочисленными операторами программ наблюдений за многолетней мерзлотой, большинство из которых осуществляются научно-исследовательскими учреждениями.

В будущем станет возможным создание различных видов прогностической продукции для многолетней мерзлоты на основе схем поверхности земли. В настоящее время демонстрационные виды продукции для прогнозирования многолетней мерзлоты близки к оперативным в климатологическом и панарктическом масштабе, но для горных районов это остается сложной задачей.

2.5.6 Продукция для мониторинга и прогнозирования айсбергов

Возможность реализации пилотного проекта КСОПВ для различных видов продукции мониторинга и прогнозирования айсбергов будет изучена КГ-ГСК и Международной рабочей группой по картированию морского льда (МРГКЛ).

Рассматривается концептуальное предложение для ИНФКОМ-5 в зависимости от результатов исследования, предложенного в пункте 2.3.

В случае реализации пилотный проект предоставит шаблон для стандартизации продукции, стандартов верификации и потенциальной возможности назначения центров подготовки прогнозов. В сферу охвата могут входить существующие виды картирования айсбергов, использование наблюдений для отслеживания айсбергов и т. д.

3. Исследовательские предложения на долгосрочную перспективу по новым типам центров

3.1 Долгосрочная перспектива — Исследовательский демонстрационный проект для высокогорных центров

Концепция высокогорных центров мониторинга и прогнозирования, предоставляющих погодные, климатические и гидрологические виды продукции, впервые обсуждалась на [Саммите ВМО по высокогорным районам](#) (2019 г.).

КГ-ГСК и ПК-МПСЗ будут координировать организацию проведения обзорного практического семинара для разработки концепции глобальных высокогорных прогностических центров совместно с ГЭИС-ПВНИДО. На семинаре будут изучены пути удовлетворения потребности в репрезентативных видах продукции для горных районов в различных масштабах в области погоды, климата и гидрологии на основе опыта и участия сети РКЦТП.

Сроки проведения семинара: 2026 год.

3.2 Долгосрочная перспектива — Центры передового опыта по процессам и обслуживанию в области криосферы

Концепция центра передового опыта по процессам и обслуживанию в области криосферы, концентрирующего внимание на потоке информации в поддержку оценок риска и других видов обслуживания, была рекомендована в контексте ускоренных изменений во всех областях криосферы и их воздействия во всем мире.

КГ-ГСК будет способствовать проведению консультаций с целью разработки концептуального предложения в тесном сотрудничестве с ПК-МПСЗ, другими органами ВМО и соответствующими партнерами, а также будет учитывать опыт, полученный в ходе реализации мероприятий настоящей дорожной карты.

Крайний срок представления предложения: ИНФОМ-5.

Решение 21 (ИНФОМ-3)

План взаимодействия КГ-Океан

Комиссия по наблюдениям, инфраструктуре и информационным системам,

отмечая, что для достижения общей цели — создания долгосрочных оперативных рабочих соглашений между ВМО и сообществом специалистов по океанической инфраструктуре на благо всех стран — необходимо ликвидировать пробелы и обеспечить руководство более высокого уровня, что требует активного участия других органов,

с признательностью отмечая работу представителей Членов в Консультативной группе по океану (КГ-Океан) по разработке проекта плана взаимодействия и его рекомендаций,

признавая, что ряд элементов этого плана нуждается в дальнейшей координации с другими органами, а также, что данные органы, вероятно, должны возглавить подобную работу,

постановляет:

- 1) поручить Группе управления ИНФОМ и постоянным комитетам оказать содействие КГ-Океан в определении и выполнении соответствующих мер и рекомендаций, касающихся ИНФОМ;
- 2) поручить президенту ИНФОМ провести консультации с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) и Советом по исследованиям, а также взаимодействовать с соответствующими заинтересованными сторонами, перечисленными в Плане взаимодействия, представленном в

дополнении, для оказания содействия в выполнении соответствующих рекомендаций, доводя любые рекомендации, касающиеся вопросов управления, до сведения Совместного совета по сотрудничеству между ВМО и МОК (ССС);

- 3) поручить президенту ИНФОМ передать данный план на рассмотрение СЕРКОМ, Техническому координационному комитету (ТКК), Консультативному комитету по вопросам политики (ККП) и СССР, чтобы определить наилучший способ продвижения вперед, а также согласовать организационные обязанности;

предлагает СЕРКОМ, ТКК, ККП и СССР рассмотреть данный план взаимодействия и определить наилучший способ продвижения вперед, а также согласовать организационные обязанности

Обоснование решения: Консультативная группа по океанам (КГ-Океан) была создана согласно [резолюции 2 \(ИНФОМ-2\)](#) «Учреждение постоянных комитетов и исследовательских групп Комиссии по наблюдениям, инфраструктуре и информационным системам (Комиссии по инфраструктуре)». Ее цель — обеспечить общую координацию в области применения мониторинга состояния океана, включая наблюдения, данные и прогнозы, в рамках ВМО и сообщества специалистов по океанической инфраструктуре. План взаимодействия представляет собой первый планируемый результат работы КГ-Океан. План взаимодействия определяет приоритетные направления деятельности на основе анализа проблем, пробелов и возможностей с опорой на ключевые стратегические документы, знания и опыт КГ-Океан, а также на основе вклада заинтересованных сторон. Последний вносят ВМО, МОК и другие соответствующие органы. Общая цель Плана взаимодействия заключается в том, чтобы помочь установить долгосрочные оперативные рабочие договоренности между ВМО и сообществом специалистов по океанической инфраструктуре на благо всех стран.

Дополнение к решению 21 (ИНФОМ-3)

План взаимодействия Консультативной группы по океанам (КГ-Океан)

1. Введение

Взаимодополняющие стратегические инициативы Всемирной метеорологической организации (ВМО), Межправительственной океанографической комиссии (МОК), Глобальной системы наблюдений за океаном (ГСНО)² и Десятилетия Организации Объединенных Наций, посвященного науке об океане в интересах устойчивого развития на 2021—2030 годы ([Десятилетие океана ООН](#)), подчеркивают взаимосвязь между системами Земли. Все они направлены на то, чтобы к 2030 году Земля стала более устойчивой уделяя особое внимание глобально интегрированной сети наблюдений, обмену данными и прогнозированию в области погоды, океана и климата.

ВМО уделяет первостепенное внимание оптимизации сбора данных, улучшению доступа к данным и управления ими, а также созданию продукции прогнозирования, в то время как МОК делает акцент на укреплении систем наблюдений, содействии в обеспечении открытого доступа к данным и разработке научных решений проблем океана. Десятилетие океана ООН стимулирует совместное накопление знаний об океане, инновации и разработку решений с участием различных заинтересованных сторон в целях обеспечения процветающего, здорового и устойчивого состояния океана к 2030 году; и Стратегия ГСНО на период до 2030 года выступает за всесторонний набор наблюдений, доступность

² Под руководством МОК/ЮНЕСКО и при совместном спонсорстве со стороны ВМО, Программы Организации Объединенных Наций по окружающей среде и Международного совета по науке.

данных и прогнозов в отношении будущего океана для сохранения жизни и устойчивого управления ресурсами. Несмотря на то что конкретные стратегические компоненты в этих документах высокого уровня различаются, все стратегии сходятся на трех ключевых элементах — наблюдениях, данных и прогнозах:

- укрепление наблюдений: создание комплексной системы наблюдений — от спутников до подводных датчиков — и восполнение пробелов в данных с помощью новых и существующих технологий;
- совершенствование практики управления данными и доступа к ним: стандартизация измерений, содействие открытому доступу и разработка надежных систем управления для эффективного обмена данными;
- прогнозирование и принятие обоснованных решений: объединение данных в реальном времени с мощными моделями для создания точных прогнозов погоды, океана и климата, что позволяет принимать обоснованные решения (и предоставлять обслуживание) в целях обеспечения более устойчивого будущего.

Дополнительную поддержку этой конвергенции можно найти в докладе, подготовленном по поручению ГСНО ([Smith, 2021](#)), в котором рассматриваются структуры поддержки глобальных и региональных наблюдений за океаном.

В рамках реформы ВМО и для большей согласованности работы ВМО и МОК был сформирован Совместный совет по сотрудничеству между ВМО и МОК (ССС). СССР работает над обеспечением командной работы и взаимодействия на различных структурных и организационных уровнях ВМО и МОК в целях улучшения прогнозирования, понимания погодных, климатических и океанических систем Земли и управления ими.

Шестикомпонентная стратегия СССР высокого уровня направлена на расширение сотрудничества, углубление знаний и совершенствование возможностей прогнозирования, эффективные системы заблаговременных предупреждений, устойчивое развитие и действия в области климата, наращивание потенциала и обучение, а также на совместные региональные подходы.

Руководствуясь этими различными стратегическими инициативами, необходимо обеспечить, чтобы участники, отвечающие за осуществление таких отдельных стратегических программ, эффективно использовали возможности друг друга. Эта потребность, а также признанная важность океана в подходе ВМО к решению проблем погоды, климата и воды на основе системы Земля привела к созданию ВМО [Консультативной группы по океанам](#) (КГ-Океан) посредством утверждения [резолюции 2 \(ИНФОМ-2\)](#) в октябре 2022 года.

2. Консультативная группа по океанам (КГ-Океан)

2.1 Роль КГ-Океан

Роль КГ-Океан заключается в том, чтобы обеспечить развитие и укрепление связей между инфраструктурой ВМО и океанической инфраструктурой (системами наблюдений, данных и прогнозирования) таким образом, чтобы это было полезно для обеих сторон. Это означает необходимость обеспечить эффективное использование ВМО возможностей, связанных с океаном (инфраструктуры и людского потенциала), и внесение вклада ВМО в развитие этих возможностей в рамках продвижения подходов на основе системы Земля в ее приоритетных областях применений, учитывая существующие структуры и партнеров, выявляя пробелы и разрабатывая стратегии их устранения.

2.2 Сфера деятельности КГ-Океан

ВМО определила для КГ-Океан подробный и обширный [круг ведения](#). Важно отметить, что КГ-Океан была учреждена как консультативная (а не экспертная или исследовательская)

группа. Для того чтобы КГ-Океан сосредоточилась на создании реальной ценности, важно, чтобы она уделяла приоритетное внимание взаимодействию, которое максимально увеличивает воздействие и ценность для пользователей метеорологического, океанического, климатического и гидрологического обслуживания там и тогда, где и когда это имеет наибольшее значение.

Важно помнить, что КГ-Океан действует в рамках более крупной экосистемы, состоящей из органов ВМО, научно-исследовательских институтов и международных партнеров. Ее эффективность зависит от способности эффективно сотрудничать с другими заинтересованными сторонами, обмениваться передовым опытом и использовать существующие инициативы для достижения максимального воздействия. Важно также отметить, что КГ-Океан представляет собой небольшое экспертное сообщество с ограниченными ресурсами.

Для того чтобы максимально повысить эффективность взаимодействия, описанного ниже, КГ-Океан, возможно, потребуется эволюционировать от структуры, управляемой исключительно ИНФКОМ, в структуру, которая получит более серьезную поддержку, легитимность и, следовательно, возможность участия в управлении со стороны органов, с которыми она взаимодействует на рабочем и техническом уровне. К ним относятся, в частности, ГСНО и Международный обмен океанографическими данными и информацией МОК (МООД) как постоянные межправительственные программы, ССС, а также некоторые другие заинтересованные стороны, указанные ниже.

3. План взаимодействия

План взаимодействия КГ-Океан — это первый шаг в рамках многоэтапной работы по укреплению и совершенствованию рабочих связей между метеорологической и океанографической инфраструктурой в контексте системы Земля. В соответствии с более широким стратегическим контекстом, о котором говорилось выше, План взаимодействия охватывает три темы: наблюдения, данные и прогнозы. Он определяет приоритетные направления деятельности на основе анализа проблем, пробелов и возможностей с опорой на ключевые стратегические документы, знания и опыт КГ-Океан и вклад заинтересованных сторон (более подробная информация изложена в [приложении](#)). Цель Плана взаимодействия заключается в том, чтобы помочь установить долгосрочные оперативные рабочие договоренности между ВМО и сообществом специалистов по океанической инфраструктуре на благо всех стран.

Осуществлением Плана взаимодействия предлагается руководить ключевым участникам, существующим в рамках нынешних ВМО, МОК, совместных спонсоров и других соответствующих органов. За некоторые из рекомендуемых действий также будет отвечать КГ-Океан. Важно отметить, что КГ-Океан будет проводить главным образом информационно-разъяснительную работу, с тем чтобы обеспечить осуществление и выполнение рекомендуемых действий.

В следующих разделах приводятся как краткое, так и подробное описание предлагаемых приоритетных направлений в рамках каждой темы.

4. Темы Плана взаимодействия

ТЕМА 1. Наблюдения за океаном — на пути к интегрированной, устойчивой, жизнеспособной и оперативной системе наблюдений

Нынешние системы наблюдений за океаном сталкиваются с проблемами устойчивости и интеграции, что ограничивает их способность в полной мере поддерживать научную деятельность, прогнозирование и обслуживание в области погоды, океана и климата. [Внутри ВМО и океанического сообщества существуют пересекающиеся программы наблюдений и инициативы, в рамках которых имеются совпадающие интересы и виды деятельности.] Цель этой темы заключается в укреплении связей между компонентом

наблюдений ВМО и океанической инфраструктурой для создания всеобъемлющей, устойчивой системы наблюдений при использовании согласованных и коллективных усилий в целях продвижения дела наблюдений за океаном и во избежание пробелов или дублирования деятельности.

КГ-Океан предлагает сосредоточиться на следующих направлениях деятельности:

1. укрепление связей между сообществами по наблюдению в рамках МОК и ВМО;
2. определение пробелов в наблюдениях в контексте областей применений регулярного обзора потребностей (РОП) ВМО;
3. роль океана в осуществлении и расширении ГОСН;
4. укрепление регионального сотрудничества на благо систем наблюдений.

ТЕМА 2. Данные и информация — на пути к свободному, открытому и неограниченному обмену удобными для поиска, доступными, функционально совместимыми и многократно используемыми (FAIR) данными

В то время как существующие стратегии и инициативы в области данных (в частности [Единая политика ВМО в области международного обмена данными о системе Земля](#) и [Политика обмена данными и информацией МОК](#)) имеют собственную направленность и аудиторию, они сходятся в своем видении глобальной системы океанических данных, которая характеризуется удобством поиска, доступностью, функциональной совместимостью и возможностью повторного использования данных (FAIR) с бесплатным, открытым и неограниченным доступом для различных заинтересованных сторон. Эта тема затрагивает все существующие усилия по устранению пробелов, удовлетворению потребностей и выполнению требований в целях укрепления и обеспечения более эффективной интеграции и предоставления данных и информации для создания продукции и обслуживания на основе взаимной выгоды.

КГ-Океан предлагает сосредоточиться на следующих направлениях деятельности:

1. структуры управления, координации и поддержки;
2. осуществление ИСВ 2.0 в отношении океанических данных;
3. интеграция Системы морских климатических данных (СМКД) в структуры ВМО и МОК и согласование с системой управления климатическими данными ВМО;
4. связь инструментов океанических метаданных и инструментов метаданных ВМО и роль ОкеанОПС³.

ТЕМА 3. Системы прогнозирования — на пути к бесшовному прогнозированию состояния системы Земля

ВМО, МОК и океаническое сообщество осуществляют взаимодополняющую деятельность по прогнозированию в области морской метеорологии, океанографии и климата. Существуют проблемы, связанные с определением потребностей пользователей, поддержанием систем наблюдений для ассимиляции и валидации, а также с обеспечением обмена и управления продукцией моделирования для целей прогнозирования и принятия обоснованных решений. Эта тема посвящена объединению сквозных видов деятельности для моделирования точных прогнозов погоды, океана и климата, что позволяет принимать

³ Совместный центр ВМО/МОК для поддержки программ наблюдений *in situ* по океанографии и морской метеорологии.

обоснованные решения (и предоставлять обслуживание) в целях обеспечения устойчивого будущего.

КГ-Океан предлагает сосредоточиться на следующих направлениях деятельности:

1. структуры управления, координации и поддержки;
2. оценка системы наблюдений и потребности в наблюдениях для целей прогноза состояния океана;
3. продукция прогнозирования состояния океана и рекомендации по использованию данной продукции для обеспечения заблаговременных предупреждений и безопасности на море;
4. оценка анализа и прогнозирования состояния океана.

5. Подробное описание приоритетных направлений деятельности

5.1 Наблюдения

5.1.1 Укрепление связей между сообществами по наблюдению в рамках МОК и ВМО

Проблема

Исторически так сложилось, что приоритетные области наблюдений ВМО и МОК не всегда совпадали. Однако в последние годы связь между океанами и атмосферой стала более очевидной, а с точки зрения ВМО интеграция наблюдений за океаном приобрела более важное значение для выполнения основных функций Организации, включая глобальное численное прогнозирование погоды (ЧПП). В то время как в настоящее время оба учреждения предпринимают усилия по координации океанической деятельности, ситуация с другими остается неясной. Отсутствие осведомленности, связей и недостаточно четкая расстановка приоритетов в сообществе океанических наблюдений между МОК и ВМО в некоторых случаях приводит к дублированию и путанице в отношении предоставляемой продукции и приоритетности наблюдений.

Рекомендуемые меры

R1) Разработать дорожную карту:

- a) для согласования случаев дублирования приоритетных областей сообщества наблюдений МОК и ВМО;
- b) для предоставления рекомендаций по приоритетным видам взаимодействия и их осуществлению.

Эта дорожная карта будет представлена ССС для получения консультаций по ее осуществлению.

Результат

Потребности пользователей удовлетворяются с помощью соответствующей целевому назначению устойчивой системы наблюдений за океаном, опирающейся на прочные и согласованные связи (включая роли и обязанности) между ВМО и сообществом океанических наблюдений.

Стратегические задачи ВМО

Цель 2: Задача 2.1 — Оптимизировать сбор данных наблюдений за системой Земля через Интегрированную глобальную систему наблюдений ВМО (ИГСНВ);

Цель 5: Задача 5.1 — Оптимизировать структуру конституционных органов ВМО для более эффективного принятия решений.

Стратегические задачи ССС

Коммуникация и взаимодействие с целью взаимного стратегического усиления; поддержка и использование приоритетных/взаимодополняющих инициатив в цепочке создания стоимости.

Партнеры / заинтересованные стороны

ССС, ИНФОМ — ПК-СНСМ, ОЭГ-ПЭСНЗ, СЕРКОМ — ПК-ММО, ПК-КЛИ, Комплексная система обработки и прогнозирования ВМО (КСОПВ), Совет по исследованиям, ГСНО и ее Группа по координации наблюдений (ГКН)

Осуществляется под руководством

Группы по наблюдениям КГ-Океан.

5.1.2 Заполнение пробелов в наблюдениях в контексте областей применений РОП ВМО

Проблема

В процессе подготовки РОП ВМО собирается информация о потребностях в наблюдениях, о возможностях системы наблюдений и привлекаются эксперты для составления заявлений о руководящих принципах в области поддержки проектирования сети наблюдений. Помимо ВМО, сообщество океанических наблюдений не имеет системной рамочной основы для установления потребностей во всех областях применений и для оценки воздействий на систему наблюдений. К заметным исключениям относятся потребности в климатических данных Группы экспертов по наблюдениям за океаном в интересах изучения климата (ГЭНОК) через Глобальную систему наблюдений за климатом (ГСНК), такие проекты, как Система наблюдений в тропической зоне Тихого океана (СНТТО), и определение потребностей в наблюдениях Экспертной группой по оперативным системам прогнозирования состояния океана (ЭГ-ОСПСО). Некоторые программы в рамках Десятилетия океана ООН, такие как Программа совместного проектирования систем наблюдений ГСНО, расширяют разработку потребностей в системах наблюдений и целенаправленную деятельность в области развития. Определены потребности в наблюдениях в областях применений ВМО и выявлены пробелы в системах наблюдений. Океаническому сообществу не хватает как ясности в отношении РОП ВМО и дизайна системы наблюдений, так и четкого диалога для заполнения выявленных пробелов во всех областях применений. Примером подобного приоритетного пробела, который затрагивает ряд областей применения, являются наблюдения с дрейфующих буев и судов; кроме того, существуют значительные риски, связанные с возможностями сбора, обработки и распространения данных наблюдений. Одним из важных направлений, которое необходимо изучить, является более активное взаимодействие с Международной морской организацией (ИМО) и крупными судовыми компаниями, чтобы помочь как поддерживать, так и наращивать (путем ликвидации существующих пробелов) объем подобных наблюдений.

Рекомендуемые меры

R2) Развивать устойчивый диалог, способствующий:

- a) формированию общего представления о пробелах в наблюдениях за океаном, выявленных в областях применений ВМО,
- b) определению процессов для установления приоритетного порядка устранения пробелов и ведущий к разработке систем и сетей,

- с) привлечению ИМО, ГСНО, ГКН и крупных судовых компаний к изучению альтернативных подходов к поддержанию и расширению масштаба наблюдений в соответствии с потребностями, в том числе обязательное проведение судовых (метеорологических и океанографических) наблюдений и установление стандартов качества и периодичности проведения подобных наблюдений и предоставляемых с ними метаданных.

В кратком отчете будут описаны пробелы (выявленные по областям применений) и даны рекомендации по расстановке приоритетов для рассмотрения в рамках мероприятий и действий ОЭГ-ПЭСНЗ (Объединенной экспертной группы по проектированию и эволюции систем наблюдений за Землей) в консультации с другими ключевыми заинтересованными сторонами, в том числе ГСНО, ГКН и ИМО, по мере необходимости.

Результат

Совершенствование климатических и метеорологических прогнозов и создание более эффективных и надежных систем наблюдений на основе диалога между сообществом океанических наблюдений и координаторами областей применений ВМО.

Стратегические задачи ВМО

Цель 2: Задача 2.1 — Оптимизировать сбор данных наблюдений за системой Земля через Интегрированную глобальную систему наблюдений ВМО (ИГСНВ);

Цель 1: Задача 1.4 — Повысить ценность и рационализировать предоставление метеорологической информации и обслуживания для поддержки принятия решений;

Цель 5: Задача 5.1 — Оптимизировать структуру конституционных органов ВМО для более эффективного принятия решений.

Стратегические задачи ССС

Коммуникация и взаимодействие с целью взаимного стратегического усиления; удовлетворение потребностей в обслуживании и реагирование на изменения; поддержка и использование приоритетных/взаимодополняющих инициатив в цепочке создания стоимости

Партнеры / заинтересованные стороны

ОЭГ-ПЭСНЗ и координаторы областей применений, ИМО, ГСНО, ГКН, судовая промышленность, ГСНК, Десятилетие океана ООН (совместное проектирование системы наблюдений за океаном, система передовых практик в области океана (СППОО))

Осуществляется под руководством

Группы по наблюдениям КГ-Океан

5.1.3 Роль океана в осуществлении и расширении ГОСН

Пробел

Глобальная опорная сеть наблюдений (ГОСН) — это новый подход ВМО к проектированию сети, впервые обязывающий Членов проводить наблюдения с минимальным горизонтальным разрешением и обмениваться ими. Ее цель заключается в создании фундаментальной основы для проведения систематических и устойчивых глобальных наблюдений для целей глобального ЧПП и реанализа климата. В рамках ГОСН только наблюдения за давлением на уровне моря (ДУМ) и температурой поверхности моря (ТПМ) являются теперь частью Технического регламента ВМО и только для районов исключительных экономических зон (ИЭЗ). Интеграция океанических наблюдений в ГОСН представляет собой основной запрос со стороны Членов ВМО и океанического сообщества. Подгруппа Целевой группы по ГОСН предлагает рекомендации по осуществлению и мониторингу соответствия существующих наблюдений за поверхностью моря в ИЭЗ. Эта группа не работает над расширением ГОСН.

Расширение ГОСН за счет океанических наблюдений требует прогресса в области формулирования потребностей в океанических наблюдениях в контексте применений ВМО, разработки технического руководства по ГОСН, представления метаданных в Инструмент анализа и обзора возможностей систем наблюдений (ОСКАР) и дальнейшего развития мониторинга качества данных океанических наблюдений в рамках ИГСНВ. Нормативные и технические рекомендации должны развиваться и совершенствоваться, чтобы поддержать усилия Членов ВМО в области океанических наблюдений за рамками ИЭЗ и поверхностных переменных, которые в настоящее время включены в ГОСН. Это потенциально открывает возможность для поддержки наименее развитых стран и малых островных развивающихся государств со стороны Фонда финансирования систематических наблюдений (ФФСН). Океаническое сообщество в целом недостаточно осведомлено о функциях, потребностях, осуществлении и возможностях для взаимодействия с ГОСН, а также о путях расширения практики наблюдений за океаном в ГОСН.

Рекомендуемые меры

- R3) Подготовить концептуальную записку для повышения осведомленности о текущих потребностях ГОСН в наблюдениях за океаном и процедурах для расширения ГОСН.
- R4) Подготовить ряд рекомендаций для ИНФКОМ по расширению ГОСН за счет наблюдений за океаном.

Результат

Улучшение ЧПП благодаря вкладу расширенной ГОСН за счет i) более эффективной интеграции и ii) расширения областей применений океанических наблюдений.

Стратегические задачи ВМО

Цель 2: Задача 2.1 — Оптимизировать сбор данных наблюдений за системой Земля через Интегрированную глобальную систему наблюдений ВМО (ИГСНВ);

Цель 1: Задача 1.4 — Повысить ценность и рационализировать предоставление метеорологической информации и обслуживания для поддержки принятия решений;

Цель 4: Задача 4.3 — Наращивать эффективные партнерские отношения в целях инвестирования в устойчивую и рентабельную инфраструктуру и предоставление обслуживания.

Стратегические задачи ССС

Коммуникация и взаимодействие с целью взаимного стратегического усиления; сотрудничество в области развития потенциала при наличии взаимной выгоды.

Партнеры / заинтересованные стороны

ПК-СНСМ: ОЭГ-ПЭСНЗ, ЦГ-ГОСН-Next, ГСНО/ГКН, государства — члены ВМО, ИНФКОМ (включая координацию расширения ГОСН с сообществами, занимающимися гидрологией и криосферой)

Осуществляется под руководством

Группы по наблюдениям КГ-Океан

5.1.4 Укрепление регионального сотрудничества на благо систем наблюдений

Возможность

Региональные структуры имеют решающее значение для предоставления обслуживания, поскольку они расположены в местах наиболее высокого спроса на обслуживание в области метеорологии, климатологии и океанографии. Региональные структуры ВМО, МОК и ГСНО не очень хорошо скоординированы ни с географической, ни со стратегической точки зрения. Ключевыми примерами эффективных национальных/региональных альянсов являются Интегрированная система наблюдений за океаном (ИООС) США и Интегрированная система морских наблюдений (ИСМН) США. Однако несмотря на значительные усилия в других регионах сильной и успешной моделью регионального сотрудничества и координации поддержки можно назвать только ЕвроГСНО. Отсутствие региональной детализации в областях применений ВМО, связанных с океаном, способствовало образованию пробела в области местного сотрудничества и передачи знаний для удовлетворения региональных потребностей. Использование региональных структур МОК и ВМО в приоритетных областях может способствовать укреплению регионального сотрудничества и осуществления, обмену знаниями и более целенаправленному предоставлению продукции и обслуживания.

Рекомендуемые меры

- R5) Разработка ряда рекомендаций (на основе тематического исследования) в отношении того, как региональные органы в рамках ВМО и МОК могли бы работать вместе для укрепления системы наблюдений, накопления и интеграции знаний и предоставления обслуживания. Рекомендации должны быть представлены ИНФКОМ и СЕРКОМ ВМО, региональным органам ВМО и МОК, региональным альянсам ГСНО и Группе экспертов по тропическим циклонам. Предлагаемое тематическое исследование: ЗПДВ о тайфуне / тропическом циклоне в Индийском океане, со ссылкой на совместное проектирование океанических наблюдений ГСНО.

Результат

Усиление воздействия на пользователей и повышение ценности систем наблюдений, соответствующих целевому назначению, за счет более ориентированных на пользователя продукции и обслуживания с опорой на более тесное региональное сотрудничество и совместную разработку приоритетных направлений деятельности.

Стратегические задачи ВМО

Цель 2: Задача 2.1 — Оптимизировать сбор данных наблюдений за системой Земля через Интегрированную глобальную систему наблюдений ВМО (ИГСНВ);

Цель 1: Задача 1.1 — Укрепить национальные системы заблаговременных предупреждений/оповещений о многих опасных явлениях, с тем чтобы расширить возможности для более эффективного реагирования на сопутствующие риски;

Цель 4: Задача 4.3 — Нарастивать эффективные партнерские отношения в целях инвестирования в устойчивую и рентабельную инфраструктуру и предоставление обслуживания.

Стратегические задачи CCC

Коммуникация и взаимодействие с целью взаимного стратегического усиления; удовлетворение потребностей в обслуживании и реагирование на изменения; поддержка и использование приоритетных/взаимодополняющих инициатив в цепочке создания стоимости; сотрудничество в области развития потенциала при наличии взаимной выгоды; использование совместных региональных подходов.

Партнеры / заинтересованные стороны

Региональные ассоциации ВМО, региональные альянсы ГСНО, подкомиссии МОК, Комитет Экономической и социальной комиссии для Азии и Тихого океана (ЭСКАТО) / ВМО по тайфунам

Осуществляется под руководством

Группы по наблюдениям КГ-Океан

5.2 Данные

5.2.1 Структуры управления, координации и поддержки

Проблема

Современный ландшафт управления океаническими данными свидетельствует о критической необходимости повышения прозрачности и координации. В рамках **СКОММ** структуру управления и координации обеспечивала Программная область — Управление данными. Несколько экспертных и других групп, таких как Группа по координации управления данными (ГКУД), Экспертная группа по морской климатологии (ЭГМК), Межпрограммная экспертная группа по интегрированному обслуживанию в области морской метеорологии и океанографии в рамках информационных систем ВМО и МОК (МПЭГ-МОИС) и другие обеспечивали координацию и постоянную разработку вопросов, связанных с управлением данными, и стратегическое руководство. В процессе реформирования ВМО Программная область — Управление данными и связанные с ней экспертные группы были расформированы, и никакие новые структуры или специализированные экспертные группы не взяли на себя их функции.

Несмотря на значительные усилия, предпринимаемые такими организациями, как **МООД** и ВМО, отрывочные разговоры и отдельные повестки дня препятствуют достижению прогресса. Кроме того, при применении единого подхода следует как избегать чрезмерного регулирования, так и сосредоточиться на координации осуществления (а не на определении стандартов и пр.), что обеспечит возможность гибкой разработки и реализации структур управления данными, которые максимально повышают функциональную совместимость систем ВМО и МОК. В настоящее время отсутствие единого направления связано с риском сохранения критических пробелов в доступности, функциональной совместимости и общей эффективности данных.

Рекомендуемые меры

R6) Подготовить обзор текущей деятельности и открытых вопросов, связанных с управлением океаническими данными (на основе ИГ-НОИС, учитывая, среди

прочего, стратегию осуществления управления данными ГКН ГСНО и такие проекты Десятилетия океана МООД/ООН, как Система океанических данных и информации (СОДИ)).

- R7) Разработать предлагаемую систему управления для постоянного скоординированного надзора за деятельностью в области океанических данных. Эта система будет включать стратегическую обзорную диаграмму, позволяющую наглядно представить, как связаны между собой все стратегии в области океанических данных, и предложение по созданию системы скоординированного надзора за деятельностью в области океанических данных. Общее внимание должно быть сосредоточено на координации осуществления управления данными (на основе согласованных открытых стандартов).

Результат

Расширение доступа к соответствующим целевому назначению океаническим данным за счет более четкого управления и надзора за управлением океаническими данными в рамках ВМО и ключевых структур/инициатив океанического сообщества.

Стратегические задачи ВМО

Цель 2: Задача 2.2 — Улучшить и расширить доступ, обмен и управление данными текущих и прошлых наблюдений системы Земля и полученной на их основе продукцией через Информационную систему ВМО.

Стратегические задачи ССС

Коммуникация и взаимодействие с целью взаимного стратегического усиления; удовлетворение потребностей в обслуживании и реагирование на изменения и поддержка; использование приоритетных/взаимодополняющих инициатив в цепочке создания стоимости.

Партнеры / заинтересованные стороны

ПК-УИИТ (данные и обмен ими, включая метаданные для обнаружения), ГКН ГСНО, МООД, ПК-СНСМ, ССС для управления и координации на высоком уровне

Осуществляется под руководством

Партнеров / заинтересованных сторон (инициатором выступит Группа по океаническим данным КГ-Океан), а результаты, связанные с управлением, будут представлены на рассмотрение ССС

5.2.2. Осуществление ИСВ 2.0 в отношении океанических данных

Возможность

Интеграция океанических данных в Информационную систему ВМО следующего поколения (ИСВ 2.0) имеет решающее значение для полного раскрытия потенциала ИГСНВ. Однако океанические данные часто фрагментированы, разрозненны и труднодоступны, что мешает нашему пониманию и способности прогнозировать глобальные изменения окружающей среды. Инкорпорируя океанические данные в ИСВ 2.0, мы сможем использовать ее надежную инфраструктуру и стандартизированные протоколы. Включение океанических данных в ИСВ 2.0 — это шаг к будущему, в котором океанические данные будут легко доступными, функционально совместимыми и использоваться на благо нашей планеты и ее обитателей.

Укрепление связей между ИСВ 2.0 и СОДИ МООД имеет особое значение в контексте обеспечения доступности океанических данных посредством ИСВ 2.0. И ИСВ 2.0, и СОДИ преследуют общую цель — оптимизировать управление и обмен океаническими данными. Они обе способствуют обеспечению функциональной совместимости с помощью стандартизированных форматов и протоколов, а также поддерживают открытый доступ и прозрачность. Кроме того, обе системы признают важность сотрудничества и взаимодействия с заинтересованными сторонами. Однако их уникальные сильные стороны и направления деятельности позволяют рассматривать их как взаимодополняющие инструменты в рамках более широкого ландшафта океанических данных. ИСВ 2.0 обеспечивает основу инфраструктуры для предоставления данных, а СОДИ предлагает комплексную среду для обнаружения, сотрудничества и обмена знаниями. Используя их совместные преимущества, можно в полной мере раскрыть потенциал океанических данных в интересах более информированного и устойчивого будущего.

Важно отметить, что ИСВ 2.0 (и СОДИ) не ограничивается обменом данными в реальном времени. Сфера применения ИСВ 2.0 шире и гибче, чем у существующей Глобальной системы телесвязи (ГСТ). Центральным компонентом системы являются стандарты обмена (мета)данными, обеспечивающие обнаружение данных и информации. Помимо механизмов обмена оперативными данными, реализованных в рамках архитектуры ИСВ 2.0, стандарты обнаружения метаданных обеспечивают связь с данными в режиме с задержкой / архивами климатических данных. Потенциальные поставщики и пользователи океанических данных в ИСВ 2.0 не осведомлены о возможностях и преимуществах ИСВ 2.0. Поставщики и пользователи данных должны четко представлять себе различные способы ввода данных и доступа к потокам данных в реальном времени и в режиме с задержкой в ИСВ 2.0.

Рекомендуемые меры

- R8) Повысить осведомленность об ИСВ 2.0 в океаническом сообществе путем проведения информационно-разъяснительных и демонстрационных мероприятий в целях включения в ИСВ 2.0 большего объема океанических данных.
- R9) Учредить механизм для координации планов работы и осуществления ИСВ 2.0 и СОДИ для обеспечения большей доступности океанических данных.

Результат

Повышение осведомленности об ИСВ 2.0 в океаническом сообществе и учреждение механизма для координации осуществления ИСВ 2.0 и СОДИ в интересах будущего, в котором океанические данные будут легкодоступными, функционально совместимыми и использоваться на благо нашей планеты и ее обитателей.

Стратегические задачи ВМО

Цель 2: Задача 2.1 — Оптимизировать сбор данных наблюдений за системой Земля через Интегрированную глобальную систему наблюдений ВМО (ИГСНВ);

Задача 2.2 — Улучшить и расширить доступ, обмен и управление данными текущих и прошлых наблюдений системы Земля и полученной на их основе продукцией через Информационную систему ВМО.

Стратегические задачи ССС

Коммуникация и взаимодействие с целью взаимного стратегического усиления; разработка стандартов и передовых методов; удовлетворение потребностей в обслуживании и реагирование на изменения; поддержка и использование приоритетных/взаимодополняющих инициатив в цепочке создания стоимости.

Партнеры / заинтересованные стороны

ГКН ГСНО для пилотных проектов, ПК-УИИТ, СОДИ/МООД

Осуществляется под руководством

ГКН/ГСНО и ПК-УИИТ (инициатором выступит Группа по океаническим данным КГ-Океан), а результаты, связанные с управлением, будут представлены на рассмотрение ССС

5.2.3 Интеграция СМКД в структуры ВМО и МОК и согласование с более широкой системой управления климатическими данными ВМО

Проблема

Основываясь на более чем 150-летнем опыте международного сотрудничества и обмена морскими наблюдениями и данными, СМКД создает единый механизм ВМО/МОК для сбора соответствующих общедоступных глобальных морских метеорологических и океанографических данных в режиме с задержкой и обмена ими. Используя существующие ресурсы и системы обмена данными, СМКД определяет скоординированную и согласованную структуру — от сбора данных до предоставления климатологических наборов данных и продукции пользователям. Важной площадкой для взаимодействия с океаническим сообществом в этом контексте стала серия практикумов по достижениям в области морской климатологии (КЛИМАР), которые проводились под эгидой Совместной технической комиссии ВМО/МОК по океанографии и морской метеорологии (СКОММ). Они обеспечили наблюдение за последними разработками и важную обратную связь со стороны сообщества в отношении СМКД и морских климатических данных.

Деятельность СМКД регулируется [Руководством](#) (ВМО-№ 471) / [Наставлением](#) (ВМО-№ 558) по морскому метеорологическому обслуживанию, в которых определены базовая структура, существующие центры и процедура аккредитации новых центров.

Однако задачи и обязанности, определенные в этих положениях, были распределены между структурами ВМО (и структурами, связанными с МОК) после реформы ВМО. Таким образом, практика внутреннего управления ВМО в отношении СМКД и других климатических данных требует ясности, чтобы обеспечить дальнейшее развитие системы.

Рекомендуемые меры

- R10) Оценить текущее состояние СМКД и предложить будущий порядок совместного управления ВМО-МОК. Такая работа будет включать в себя следующее:
- а) освещение преимуществ системы; б) предполагаемые цели и рекомендации на случай, если возникнет необходимость изменить форму/направление;
 - с) возможности извлечения уроков из СМКД в контексте разработки систем управления климатическими данными.
- R11) Возродить практикумы КЛИМАР в качестве платформы для экспертов и обмена мнениями по вопросам сквозного использования данных.

Результат

Укрепление и повышение эффективности структур управления СМКД со стороны МОК-ВМО и четкое определение внутренних обязанностей ВМО в отношении управления климатическими данными, включая дальнейшее успешное развитие СМКД.

Стратегические задачи ВМО

Цель 2: Задача 2.2 — Улучшить и расширить доступ, обмен и управление данными текущих и прошлых наблюдений системы Земля и полученной на их основе продукцией через Информационную систему ВМО.

Стратегические задачи ССС

Коммуникация и взаимодействие с целью взаимного стратегического усиления; разработка стандартов и передовых методов; удовлетворение потребностей в обслуживании и реагирование на изменения; поддержка и использование приоритетных/взаимодополняющих инициатив в цепочке создания стоимости.

Партнеры / заинтересованные стороны

ПК-УИИТ и МООД (включают представителей ГСНО, ГСНО-ГСНК/ГЭНОК, ГСНК/ГЭАНК)

Осуществляется под руководством

Партнеров / заинтересованных сторон (инициатором выступит группа по океаническим данным КГ-Океан), а результаты, связанные с управлением, будут представлены на рассмотрение ССС

5.2.4 Связь инструментов океанических метаданных и инструментов метаданных ВМО и роль ОкеанОПС

Возможность

ОСКАР представляет собой глобальное хранилище возможностей систем приземных и космических наблюдений, созданное ВМО. ОСКАР — это веб-инструмент, в котором производится регистрация, управление и архивирование метаданных. Он фиксирует потребности в системе наблюдений и позволяет критически оценить, насколько реальные возможности соответствуют потребностям. Это помогает оценить, где, как и почему проводятся наблюдения. ОСКАР представляет собой компонент процесса РОП, который позволяет выявлять потенциал и поддерживать оценку пробелов, а также предоставляет информацию, важную для Системы мониторинга качества данных ИГСНВ. Метаданные систем наблюдения за океаном в настоящее время поступают в ОСКАР через систему ОкеанОПС, и СКММ-5 определила ОкеанОПС в качестве авторитетного источника таких метаданных из глобальных сетей наблюдений.

Область применения ОкеанОПС не сводится только к метаданным. ОкеанОПС также отвечает за выдачу ГНС-ИД/ИСИ для платформ наблюдений за океаном, осуществление и мониторинг ключевых показателей эффективности и выполнение задач, сопоставимых с задачами региональных центров ИГСНВ, но в отношении глобального океана. Благодаря этим возможностям ОкеанОПС обеспечивает важные функции, необходимые для беспрепятственной интеграции океанических данных в ИГСНВ. Поэтому необходимо обеспечить полную функциональную совместимость ОкеанОПС и ИГСНВ, что должно быть отражено в рабочем плане ОкеанОПС и в нормативных материалах структуры ИГСНВ. Следует также принять меры к тому, чтобы все Члены были осведомлены о необходимости регистрации метаданных, обрабатываемых ОкеанОПС, через ОкеанОПС (во избежание дублирования в ОСКАР) либо создания механизмов согласования.

Рекомендуемые меры

R12) Разработать рекомендации в отношении полного осуществления стратегии внедрения межсетевых данных ГКН ГСНО (касающейся, в частности, гармонизации и сбора метаданных).

- R13) Согласовать планы работы ГКН/ГСНО и ПК-СНСМ/ИНФКОМ и установить устойчивый порядок координации и управления для согласования планов работы с ИГСНВ и ИСВ 2.0.

Результат

Более четкие структуры управления ОкеаноПС и более тесная связь между службами ОкеаноПС и системами ВМО для обеспечения беспрепятственной интеграции океанических данных в ИГСНВ.

Стратегические задачи ВМО

Цель 2: Задача 2.2 — Улучшить и расширить доступ, обмен и управление данными текущих и прошлых наблюдений системы Земля и полученной на их основе продукцией через Информационную систему ВМО.

Стратегические задачи ССС

Коммуникация и взаимодействие с целью взаимного стратегического усиления; разработка стандартов и передовых методов; удовлетворение потребностей в обслуживании и реагирование на изменения; поддержка и использование приоритетных/взаимодополняющих инициатив в цепочке создания стоимости; сотрудничество в области развития потенциала при наличии взаимной выгоды.

Партнеры / заинтересованные стороны

ГСНО, ГКН/ГСНО, ПК-СНСМ (ЭГ-ИИ), ОкеаноПС

Осуществляется под руководством

Исполнительного органа ГКН и ПК-СНСМ (ЭГ-ИИ) (инициатором выступит Группа по океаническим данным КГ-Океан), а аспекты управления будут представлены на рассмотрение ССС

5.3 Прогнозирование

5.3.1 Структуры управления, координации и поддержки

Возможность

В настоящее время координация прогнозирования состояния океана в рамках ВМО и МОК ограничивается ЭГ-ОСПСО (которая входит в состав ГСНО) и различными связями в контексте прогнозирования состояния системы Земля и областей применений ВМО. В то же время динамично развивается и растет более широкое сообщество специалистов по прогнозированию состояния океана (что подтверждается созданием Центра сотрудничества Десятилетия (ЦСД) по прогнозированию состояния океана). КГ-Океан имеет возможность активно поддерживать и влиять на развитие и интеграцию координации прогнозирования состояния океана со структурами ВМО таким образом, чтобы это было полезно для развития возможностей прогнозирования состояния океана и систематического предоставления прогностических данных для все более широкого спектра применений.

Рекомендуемые меры

- R14) Установить функциональную связь между ЭГ-ОСПСО и КСОПВ/ПК-МПСЗ; (включает создание механизма для поддержания в актуальном состоянии руководства ЭГ-ОСПСО в качестве совместной публикации МОК-ВМО для океанического сообщества; и руководство работой ЭГ-ОСПСО по подготовке под

руководством КСОПВ РОП в продукции и прогнозах, связанных с океаном, для согласованных областей применений, в координации с соответствующими постоянными комитетами СЕРКОМ).

- R15) Работать с ЦСД по прогнозированию состояния океана над изучением связей с научными исследованиями по прогнозированию состояния системы Земля (через ВПМИ/ВПИК).
- R16) Инициировать и поддерживать дискуссии по вопросам долгосрочного развития постоянной структуры прогнозирования состояния океана, включая ее координационное взаимодействие с более широкой областью прогнозирования состояния системы Земля, в том числе с научно-исследовательскими (ВПМИ/ВПИК) и оперативными (КСОПВ) системами.

Результат

Укрепление систематической международной координации в области прогнозирования состояния океана, оптимизация интеграции системы Земля и предоставление обслуживания обществу путем укрепления партнерских связей (от результатов исследований к оперативной деятельности, в рамках всей системы Земля и в отношении обслуживания / областей применений).

Стратегические задачи ВМО

Цель 2: Задача 2.3 — Способствовать доступу и использованию продукции численного анализа и прогнозирования системы Земля во всех временных и пространственных масштабах, получаемых благодаря Комплексной системе обработки и прогнозирования ВМО;

Цель 5: Задача 5.3 — Поощрять равное, эффективное и широкое участие в управлении, научном сотрудничестве и принятии решений.

Соответствующее стратегическое направление деятельности ССС

Коммуникация и взаимодействие с целью взаимного стратегического усиления; удовлетворение потребностей в обслуживании и реагирование на изменения.

Партнеры / заинтересованные стороны

ЭГ-ОСПСО / ЦСД по прогнозированию состояния океана и КСОПВ / ПК-МПСЗ

Осуществляется под руководством

ЭГ-ОСПСО и ПК-МПСЗ (инициатором выступит Группа прогнозирования состояния океана КГ-Океан), а вопросы, связанные с управлением, будут представлены на рассмотрение ССС

5.3.2 Оценка системы наблюдений и потребности в наблюдениях для целей прогноза состояния океана

Возможность

РОП (в наблюдениях) ИГСНВ перестраивается в контексте подходов на основе системы Земля. Существует необходимость и возможность организовать и координировать сбор наблюдений и обзор потребностей в наблюдениях со стороны сообщества специалистов по прогнозированию состояния океана для использования в рамках РОП ВМО в координации с СЕРКОМ.

Рекомендуемые меры

- R17) Сделать ЭГ-ОСПСО координатором в рамках ГСНО для сбора информации о потребностях в океанических наблюдениях у сообщества специалистов по океаническим применениям в сотрудничестве с OceanPredict.

Результат

Прогнозирование состояния океана улучшается благодаря доступу к наблюдениям, соответствующим целевому назначению.

Соответствующие стратегические задачи ВМО

Цель 2: Задача 2.1 — Оптимизировать сбор данных наблюдений за системой Земля через ИГСНВ.

Соответствующее стратегическое направление деятельности ССС

Поддержка и использование приоритетных/взаимодополняющих инициатив в цепочке создания стоимости.

Партнеры / заинтересованные стороны

ЭГ-ОСПСО, OceanPredict (целевая группа по оценке системы наблюдений и рабочие группы по оперативным системам) и проект SynObs (Синергетическая сеть наблюдений для прогнозирования океана) в рамках программы Десятилетия океана ООН

Осуществляется под руководством

ЭГ-ОСПСО (инициатором выступит Группа прогнозирования состояния океана КГ-Океан)

*5.3.3 Реагирование на авторитетные руководящие указания в отношении потребностей в продукции прогнозирования состояния океана**Пробел*

ООН и ВМО настоятельно призывают всех Членов расширить обслуживание в области защиты жизни и имущества, используя для этого несколько известных механизмов. В частности, например, осуществление инициативы ООН «Заблаговременные предупреждения для всех» (ЗПДВ), положений ИМО / Международной гидрографической организации и Единой политики ВМО в области данных. Необходимо определить и предоставить набор продукции прогнозирования состояния океана для удовлетворения этих основных потребностей пользователей.

Рекомендуемые меры

- R18) Поддерживать разработку РОП в продукции и прогнозах, связанных с океаном, для согласованных областей применений; в рамках этой работы определить важнейшие виды океанической продукции и их форматы (используя «основные данные» в [Наставлении по КСОПВ](#) (ВМО-№ 485) для поддержки Членов в предупреждении об опасных явлениях, связанных с океаном (в соответствии с [Руководством по морскому метеорологическому обслуживанию](#) (ВМО-№ 471)).

- R19) Обеспечить свободное и неограниченное распространение «основных данных» систем прогнозирования состояния океана.
- R20) Изучить, как поддержать укрепление связей между ЭГ-ОСПСО и соответствующими видами деятельности СЕРКОМ.

Результат

Члены ВМО располагают соответствующими целевому назначению продукцией и обслуживанием в области предупреждения об опасных явлениях, связанных с океаном, для усиления защиты жизни и имущества.

Соответствующие стратегические задачи ВМО

Цель 1: Задача 1.1 — Укрепить национальные системы заблаговременных предупреждений/оповещений о многих опасных явлениях, с тем чтобы расширить возможности для более эффективного реагирования на сопутствующие риски;

Цель 2: Задача 2.3 — Способствовать доступу и использованию продукции численного анализа и прогнозирования системы Земля во всех временных и пространственных масштабах, получаемых благодаря Комплексной системе обработки и прогнозирования ВМО.

Соответствующие стратегические направления деятельности ССС

Удовлетворение потребностей в обслуживании и реагирование на изменения; поддержка и использование приоритетных/взаимодополняющих инициатив в цепочке создания стоимости.

Партнеры / заинтересованные стороны

КСОПВ (ПК-МПСЗ), ЭГ-ОСПСО, ЦСД ПО, ПК-ММО СЕРКОМ, ЭГ-БМ, координаторы МЕТЗОНА, ИМО, МГО

Осуществляется под руководством

ПК-МПСЗ/КСОПВ и ЭГ-ОСПСО (инициатором выступит Группа прогнозирования состояния океана КГ-Океан) в тесной координации с ПК-ММО и с рекомендациями по вопросам управления, которые будут представлены на рассмотрение ССС

5.3.4 Оценка анализа и прогнозирования состояния океана

Возможность

Ограниченное взаимодействие между сообществами специалистов по прогнозированию состояния океана и системы Земля распространяется и на оценку прогнозов. Это ограничивает возможность учиться и осваивать новые способы повышения точности прогнозирования. Для решения этой проблемы существуют значительные возможности для обмена опытом, методами и передовой практикой в области анализа моделей, оценки прогнозов и верификации всех компонентов системы Земля в рамках как научно-исследовательской, так и оперативной деятельности, сосредоточенной на океанической области.

Рекомендуемые меры

- R21) Установить надежные каналы связи между соответствующими группами, участвующими в подготовке оценок.

- R22) Договориться о передовой практике оценки аналитических материалов и прогнозов.
- R23) Способствовать переходу от научных исследований к оперативной деятельности в отношении стандартизированной и согласованной системы оценочных показателей в области прогнозирования состояния океана.

Результат

Совершенствование (повышение точности и эффективности) продукции и обслуживания на основе: а) скоординированной систематической оценки точности прогнозирования состояния океанов и системы Земля в рамках научных исследований и оперативной деятельности и в разных временных масштабах; б) усиления взаимодействия между научно-исследовательской и оперативной деятельностью.

Соответствующие стратегические задачи ВМО

Цель 2: Задача 2.3 — Способствовать доступу и использованию продукции численного анализа и прогнозирования системы Земля во всех временных и пространственных масштабах, получаемых благодаря Комплексной системе обработки и прогнозирования ВМО.

Соответствующие стратегические направления деятельности ССС

Разработка стандартов и передовых методов; поддержка и использование приоритетных/взаимодополняющих инициатив в цепочке создания стоимости.

Партнеры / заинтересованные стороны

ЦСД по прогнозированию состояния океана, ЭГ-ОСПСО/ГСНО, Целевая группа по взаимному сравнению и валидации OceanPredict и РГ-ОПОС (Рабочая группа по операционным системам), СРГИПОП ВПМИ

Осуществляется под руководством

ЭГ-ОСПСО должна возглавить работу по обсуждению вопросов производства и реанализа в реальном времени системы показателей оперативной верификации с соответствующими группами ВМО, особенно с ПК-МПСЗ, Совместной рабочей группой ВПМИ по исследованиям в области проверки оправдываемости прогнозов и Целевой группой по взаимному сравнению и валидации OceanPredict. (Инициатором выступит Группа прогнозирования состояния океана КГ-Океан)

ПРИЛОЖЕНИЕ

Взаимодействие с заинтересованными сторонами: текущая оценка согласованности усилий и связей между океанической инфраструктурой и ВМО в рамках двусторонних дискуссий

КГ-Океан необходимо наладить стратегическое взаимодействие с ключевыми органами как в рамках ВМО (включая Комиссию по обслуживанию и Совет по исследованиям), так и за ее пределами, чтобы направлять усилия, касающиеся деятельности в области наблюдений, данных и прогнозирования.

Началось взаимодействие с заинтересованными сторонами, и ниже приводится краткое изложение бесед с соответствующими председателями/руководителями (важно отметить, что эти беседы являются лишь началом постоянных консультаций с заинтересованными сторонами; предполагается, что КГ-Океан будет общаться с ними на регулярной основе):

Группа	Основные тезисы
Президент ИНФОМ	Небольшой размер океанического сообщества в сочетании с частичным пересечением функций комитетов ВМО и океанического сообщества приводит к дублированию и путанице. По возможности использовать существующие комитеты. Неустойчивое положение с финансированием наблюдений за океаном. Нужна более устойчивая система, реагирующая на потребности членов. Рассмотреть возможность укрепления партнерских отношений (не только в рамках ГСНО и ВМО), где это необходимо.
ПК-СНСМ/ПК-ИПП	Выявлять связи между структурами / с партнерами, а не полагаться на отдельных людей. Поощрять планирование преемственности и передачу знаний. Регулярное информирование о новых инициативах и ранее вовлечение для участия в консультациях. Укреплять сотрудничество с ПК-ИПП в области международной стандартизации и интеграции измерений. Назначить членов КГ-Океан на ведущие роли в основных областях взаимодействия
ПК-МПСЗ (КСОПВ)	Важность наличия доступа к соответствующим экспертам в отношении океана. Понимание того, что является важным для океанического сообщества (сообщества специалистов по прогнозированию), в частности потребностей в наблюдениях и продукции. Необходимы механизмы взаимодействия и обмена информацией.
ПК-УИИТ	КГ-Океан может поделиться знаниями по вопросам адаптации учебных материалов и преимуществ ИСВ 2.0 для обмена данными, а также помочь определить, где ИСВ 2.0 может улучшить доступ к данным и обмен ими. Поддержка центров океанических данных в их трансформации в центры ИСВ 2.0 может способствовать повышению доступности данных. Необходимо укрепить связь между ИСВ 2.0 и СОДИ/МООД и ГКН/ГСНО.
ГСНО	ГСНО необходимо адаптироваться и развиваться, выходя за рамки научного сообщества. Доведение информации о масштабе деятельности программы и определение приоритетов КГ-Океан может способствовать усилению позиции ГСНО в ВМО. Потенциал использования ФФСН/ГОСН для поддержки наименее развитых стран. ГСНО в значительной степени опирается на непредусмотренные мандатом позиции. Представляет собой проблему для обеспечения устойчивости.
ГЭНОК (ГСНО/ГСНК/ВПИК) ГКН (ГСНО)	Определить, где именно наблюдения за океаном имеют решающее значение для успеха ВМО. Участие в реформе ГСНО и рекомендации по усилению вклада. Оценка интеграции океана в рамках программ ВМО. Разработка океанических компонентов ГОСН и Глобальной службы наблюдения за парниковыми газами (ГСНПГ). Укрепление связей в отношении таких областей применений, как погода, экстремальные явления, мониторинг климата. Повышение роли океана в органах ВМО.
УКР, Наблюдение	Координация деятельности по решению инфраструктурных задач в рамках Десятилетия хорошо согласуется с основными компонентами инфраструктуры.

Группа	Основные тезисы
УКР, Обмен данными УКР, Прогнозирование состояния океана	Потенциал ВМО для использования мероприятий по проведению преобразований Десятилетия для достижения прогресса. ВМО могла бы предоставлять поддержку/консультации и сотрудничать по вопросам обмена опытом, в частности в таких областях, как региональная координация и взаимодействие, совместное планирование деятельности. Потенциал для рассмотрения этих видов деятельности, ориентированных на океан, в контексте подходов на основе системы Земля и более широких связей и событий, которые можно было бы использовать.

Основные заинтересованные стороны для предстоящего взаимодействия:

Группа	Приоритетные темы для обсуждения
Комиссия по обслуживанию (президент)	Обсудить стратегию участия в работе СЕРКОМ по вопросам, связанным с предоставлением информации об океане.
ЭГ-ОСПСО/ГСНО	Обсуждение формализации связи с ВМО, участие в более широких обсуждениях по вопросам прогнозирования состояния системы Земля.
МООД	Обсуждение путей согласования и определения приоритетов соответствующих видов деятельности ВМО в отношении управления океаническими данными и обмена ими.
ПК-ММО/СЕРКОМ и другие приоритетные ПК	На основании обсуждения с президентом СЕРКОМ.
Совет по исследованиям	Стратегические приоритеты в отношении роли океана в развитии прогнозирования состояния системы Земля
ГСНПГ	Встреча с руководителем и ведущим автором группы по подготовке текстов об океане для обсуждения позиционирования океана в планах и привлечения экспертов по океану, потенциальных стратегий взаимодействия с финансирующими организациями.
МКПОУ (ГСНО-СКОР)	Обсудить первоначальное взаимодействие с ГСНПГ и ту поддержку, которую может оказать КГ-Океан.
КГ-ГСК	Обсудить роль КГ в ИНФОМ и изучить возможности синергии (например, морской лед).
ССС	Обсудить роли и обязанности, совместные приоритеты, рабочие механизмы и то, как КГ-Океан будет пересекаться с СССР в будущем.

Решение 22 (ИНФОМ-3)

Рекомендации Целевой группы по гидрологии

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ

постановляет:

- 1) принять к сведению окончательный отчет Целевой группы по гидрологии (ЦГ-Гидро) и ее рекомендации, представленные в дополнении 1 к настоящему решению;

- 2) принять рекомендацию о создании Консультативной группы по гидрологии с кругом ведения, представленным в дополнении 2 к настоящему решению, что будет принято в качестве части [резолюции 3 \(ИНФОМ-3\)](#);
- 3) поручить Группе управления Комиссии и постоянным комитетам выполнить соответствующие рекомендации;
- 4) поручить президенту Комиссии в консультации с президентом Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды и председателю Координационной группы экспертов по гидрологии взаимодействовать с заинтересованными сторонами по мере необходимости для разработки и выполнения соответствующих рекомендаций.

Полный отчет ЦГ-Гидро см. в INFCOM-3/INF. 8.5(3).

Обоснование решения: задача Целевой группы по гидрологии (ЦГ-Гидро) заключалась в том, чтобы предложить новый подход к деятельности в области гидрологии в рамках ИНФОМ, включая общую координацию и улучшение понимания Членами, и в частности их национальными метеорологическими и гидрологическими службами.

Дополнение 1 к решению 22 (ИНФОМ-3)

Целевая группа по гидрологии Окончательный отчет и рекомендации

Целевая группа по гидрологии (ЦГ-Гидро) была создана летом 2023 года Группой управления Комиссии по наблюдениям, инфраструктуре и информационным системам (ИНФОМ) с целью предложить новую структуру и подход к вопросам в области гидрологии в рамках ИНФОМ. Это необходимо для обеспечения эффективной реализации инфраструктурного компонента Плана действий ВМО в области гидрологии (Кг-Внеоч.(2021)) в контексте принятого в ВМО подхода на основе системы Земля (СЗ).

ЦГ-Гидро провела четыре онлайн-заседания в сентябре 2023 года, декабре 2023 года и январе 2024 года. Основное внимание уделялось различным вариантам структуры, связанной с Консультативной группой по гидрологии, и дополнительным рекомендациям, касающимся связей с другими мероприятиями ИНФОМ. Вследствие нехватки времени было решено, что элементы круга ведения ЦГ-Гидро, которые не удалось рассмотреть до начала ИНФОМ-3, будут рассмотрены после завершения сессии с учетом пересмотренной структуры, если она будет принята.

Главным результатом стал полный текст отчета, представленный в документе INFCOM-3/INF. 8.5(3), а также список ключевых рекомендаций для рассмотрения ИНФОМ-3.

Введение

ЦГ-Гидро признала, что мир кардинально меняется: с одной стороны, на нашей планете наблюдаются определенные геофизические процессы; а с другой стороны, открываются новые возможности для совершенствования методов наблюдений и моделирования для более качественного прогнозирования будущих явлений. Кроме того, меняются методы и темпы нашей работы по решению задач в соответствующих областях ВМО в ответ на растущие потребности в надежных, бесплатных и своевременных данных. Это изменение, в свою очередь, влияет на роль национальных метеорологических и гидрологических служб (НМГС) и ВМО.

Сегодня ИНФКОМ как никогда важно поддерживать Членов и служить для них проводником в эту новую эпоху, а также подчеркивать ценность подхода, основанного на СЗ, для всех Членов, во всех научных и дисциплинарных областях. ВМО должна внимательно относиться к новым возможностям взаимодействия с любыми новыми данными или научными разработками, которые могут принести пользу общественности и Членам ВМО, и, соответственно, обеспечить адаптацию текущей практики и приоритетов.

Признается, что при определении будущей научно-исследовательской деятельности и оперативной поддержки систем мониторинга и прогнозирования ВМО в основном придерживается перспективного видения, основанного на СЗ. Таким образом, движение воды, углерода и энергии через все компоненты СЗ требует, чтобы в рамках ИНФКОМ были признаны и представлены все основные компоненты СЗ, в том числе атмосфера, океан, морской лед и поверхность суши, *включая* гидрологические компоненты системы (например, поверхностные воды, снег, лед, влажность почвы, грунтовые воды), ее основные потоки (например, сток, расход, активная теплота и скрытое тепло, эвапотранспирация) и даже антропогенную деятельность в рамках этой системы (например, водохранилища, добыча подземных вод, межбассейновые водоотводы). Гидрологические компоненты СЗ зачастую оказывают наибольшее воздействие и представляют наибольшую ценность для общества, учитывая их основополагающую роль в обеспечении водной и энергетической безопасности, а также возникновении экстремальных явлений, таких как паводки и засухи.

В то же время появляются нетрадиционные источники и поставщики информации СЗ и связанного с этой системой обслуживания (например, искусственный интеллект, краудсорсинг и т. д.). ВМО должна учитывать эти инновации в области сбора данных, моделирования, прогнозирования и распространения продукции при разработке инфраструктуры наблюдений и моделирования СЗ.

Наконец, что не менее важно, ЦГ-Гидро напоминает, что самыми ценными ресурсами являются время и энергия людей и добровольцев, которые верят в миссию ВМО и руководствуются ею. ВМО должна разумно и эффективно использовать этот ресурс и мотивировать к участию, оставаясь в курсе передовых достижений науки и практики в области СЗ.

Кроме того, ЦГ-Гидро определила и перечислила основные проблемы и возможности для гидрологии в рамках ИНФКОМ. Здесь кратко представлены ключевые пункты, раскрытые в документе [INFCOM-3/INF. 8.5\(3\)](#).

Проблемы в области гидрологии в рамках ИНФКОМ

- Различные методы работы: ИНФКОМ в значительной степени является преемницей бывшей Комиссии по основным системам (КОС) (сфера охвата и специализированные опыт и знания). Она также продолжает практику многочисленных целевых групп КОС, в то время как ранее существовавшая Комиссия по гидрологии (КГи) работала с единственной Консультативной рабочей группой, которая занималась всей цепочкой формирования ценности в области гидрологии. Это затрудняет обеспечение согласованности подходов.
- Вопросы культуры и членства: в настоящее время все председатели постоянных комитетов (ПК) работают в метеорологических службах, как и большинство экспертов. Может ли ИНФКОМ без колебаний согласиться с тем, что председателями или сопредседателями ПК, например Постоянного комитета по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля (ПК-МПСЗ), могут быть эксперты, представляющие различные аспекты СЗ, включая гидрологию, при условии, что они обладают квалификационными знаниями в области вопросов, связанных с инфраструктурой?
- Разобщенность сообществ: сохраняющееся восприятие «мы и они» среди различных дисциплинарных сообществ ввиду, среди прочего, того факта, что для некоторых

Членов ответственность за метеорологию и гидрологию не входит в компетенцию одной и той же организации, может препятствовать сотрудничеству и сплоченности в рамках ИНФКОМ и других органов ВМО (например, Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ), Совета по исследованиям (СИ)).

- Дисбаланс тем и компонентов СЗ в рамках ПК, что может подорвать готовность к участию и потенциально препятствовать достижению коллективных целей.
- Цепочка представления отчетности и утверждения документов любого тематического подкомитета (например, Объединенной экспертной группы по гидрологическому мониторингу (ОЭГ-ГИДМОН)) может показаться слишком длинной и усложненной; тот факт, что такие документы рассматриваются и утверждаются органами, в состав которых входит мало гидрологов, может быть воспринят негативно (как внутри, так и вне структуры).
- Ограниченная ясность и понимание того, как представлены субдисциплинарные знания (например, в области суши/гидрологии, криосферы) в комитетах и советах ВМО. ИНФКОМ проводит более активную работу по решению задач в области суши/гидрологии, таких как прогнозирование на основе СЗ, что является одним из примеров необходимости осведомленности о сферах деятельности различных подразделений ВМО в рамках всей Организации.
- Отличия процессов и практики обработки данных, моделирования и прогнозирования в области метеорологии и гидрологии (обусловленные традициями науки и инженерного дела) представляют собой проблему для быстрой консолидации. Чтобы договориться о будущем, всем сторонам необходимо признать различные пути развития.

Польза экспертных знаний и опыта в области гидрологии для ИНФКОМ

- Рассмотрение тем в области гидрологии может способствовать освоению более широкого подхода к СЗ, а также поиску новых решений проблем и новых областей применения существующих решений.
- Экспертные знания и опыт в области гидрологии помогают создавать замкнутые естественные циклы (энергия, углерод, вода) с помощью критически важных, соответствующих целевому назначению систем наблюдений и моделирования.
- Интеграция гидрологического сообщества позволяет привлечь ключевые заинтересованные стороны и пользователей для более эффективного использования метеорологических и климатических данных и продукции. Единое сообщество ВМО улучшит совместный результат.

Потенциальная польза от ИНФКОМ для гидрологии

- Существующие инструменты/системы можно использовать на благо гидрологии, находя способы модификации/применения существующих сопряженных систем и практики мониторинга и прогнозирования СЗ, чтобы выдвинуть на первый план области, проблемы и задачи, связанные с суши/гидрологией.
- В рамках гидрологии могут быть сформулированы требования к эффективности, выходной и информационной продукции других компонентов СЗ и наоборот, может быть сформирована практика и приоритеты в области разработки моделей суши и гидрологии.
- Двусторонняя коммуникация между экспертами в области других компонентов СЗ (атмосфера, океан, криосфера, другие компоненты суши) для повышения осведомленности о том, что доступно из ключевых сопряженных областей (например, сток талых вод в реки (криология — гидрология), пресноводные стоки в прибрежных районах (океан — гидрология), влажность почвы (биосфера, связь сельского хозяйства с гидрологией)), как и в каком качестве (включая глобальную и

региональную продукцию), что способствует ускоренному освоению и использованию последних достижений в области СЗ и функциональной совместимости. Коммуникация должна также продемонстрировать, как метеорология и гидрология дополняют друг друга, особенно в развивающихся странах.

На основании этого анализа ЦГ-Гидро сформулировала, каким должно быть конечное состояние интеграции:

Определение конечного состояния

Улучшено восприятие деятельности в области гидрологии и деятельности, связанной с сушей, в ИНФКОМ, как внутри Комиссии (соответствующие требования и вклад), так и за ее пределами (привлечение к участию гидрологического сообщества). Интеграция носит актуальный характер, логически и физически оформлена в рамках подхода на основе СЗ и имеет практическую ценность для достижения результатов.

В долгосрочной перспективе различия более не играют роли: напротив, все сводится к общей цели для всех дисциплинарных экспертов ИНФКОМ и, в более широком смысле, ВМО — обеспечивать проведение наблюдений, моделирования и прогнозирования СЗ для удовлетворения потребностей людей.

Благоприятные условия и что необходимо предотвратить

- Круг ведения любого координирующего органа должен:
 - a) обеспечивать предотвращение перегрузки ключевых экспертов за счет включения дополнительных ролей/задач;
 - b) быть эффективным и иметь ограниченный объем и сферу охвата;
 - c) отражать и учитывать структуру подразделений в области гидрологии в рамках других органов ВМО и вместе с тем по возможности опираться на существующие механизмы координации.
- Должна быть обеспечена взаимодополняемость Консультативной группы по гидрологии (КГ-Гидрология) и технического(их) органа(ов) с мандатом в области гидрологии (ОЭГ-ГИДМОН до 2024 г.), которые будут созданы ИНФКОМ-3, чтобы сохранить актуальность обоих органов и избежать снижения эффективности какого-либо из них или дублирования их функций.
- В круге ведения необходимо предотвратить риск возникновения конфликта между сферами ответственности ПК и консультативных групп в целом (кто принимает решения?)
- Решение должно обеспечивать прямую связь с экспертными опытом и знаниями / требованиями / потребностями в области гидрологии для группы управления / президента / председателей ПК.
- Следует рассмотреть вопрос об определении приоритетности задач в области гидрологии в рамках ИНФКОМ, чтобы сосредоточить людские ресурсы на выполнении наиболее важных из них в соответствии с Планом действий ВМО в области гидрологии, принятым Кг-Внеоч.(2021), и потенциально использовать одно «образцовое» мероприятие для продвижения.
- Определение показателей для оценки успешности КГ-Гидрология.

Что необходимо для достижения конечного состояния (результатов)?

- Установлена быстрая (прямая) связь для координации деятельности в области гидрологии с Группой управления ИНФКОМ (ГУ ИНФКОМ).
- Осуществляется совместная разработка всех целей и мероприятий ИНФКОМ всеми сообществами (всегда).

- Метеорологи и гидрологи обладают более глубоким (единым) пониманием подхода, основанного на СЗ.
- Понимание и развитие присутствия гидрологии в рамках деятельности ИНФКОМ помогает привлечь к участию представителей сообщества и улучшить внешнее восприятие роли ВМО в вопросах, связанных с водными ресурсами.
- Простой механизм, позволяющий наладить и контролировать совместную работу ИНФКОМ и СЕРКОМ по общим вопросам (например, обзор Руководства), чтобы не предусматривать уникальную форму сотрудничества.
- Увеличение числа гидрологов, участвующих в работе технических комитетов ИНФКОМ. [Сбалансированная представленность компонентов СЗ (атмосфера, океан, криосфера, другие компоненты суши), а также различных аспектов моделирования СЗ (палеогидрология, исторические данные, мониторинг, прогнозирование, проекции.)]

По итогу этих общих соображений составлен полный перечень возможных рекомендаций в соответствующем информационном документе с целью их анализа после окончания ИНФКОМ-3. ИНФКОМ предлагается принять перечисленные ниже рекомендации, как наиболее важные.

Ниже кратко изложены ключевые рекомендации ЦГ-Гидро:

№	Рекомендация	Ведущий орган
1	Учредить Консультативную группу по гидрологии	ИНФКОМ
2	Усилить совместную разработку целей и мероприятий со всеми сообществами, в том числе с учетом требований и результатов региональных форумов советников по гидрологии в соответствии с поручением, содержащимся в резолюции 4 (КГ-Внеоч.(2021))	ГУ ИНФКОМ
3	Подготовить информационный/вводный пакет ВМО по организации, аббревиатурам, обзорному представлению гидрологической деятельности в рамках ИНФКОМ, а также рассмотреть вопрос о коммуникации и представлении действий и мероприятий с целью привлечения к участию в его деятельности представителей гидрологического сообщества и других областей	КГ-Гидро
4	Через Генерального секретаря призывать постоянных представителей в координации с советниками по гидрологии к выдвижению большего числа кандидатур экспертов по гидрологии в Сеть экспертов и к участию в мероприятиях ВМО	П/ИНФКОМ
5	Назначать достаточное количество экспертов по гидрологии на уровне ПК и обеспечивать рассмотрение конкретных тем в области гидрологии. Председатель и сопредседатели ПК должны применять широкий междисциплинарный подход ко всем аспектам деятельности ПК	П/ИНФКОМ, председатель и сопредседатели ПК
6	Расформировать ОЭГ-ГИДМОН и создать новые или сохранить существующие технические гидрологические группы в рамках всех ПК	ГУ ИНФКОМ
7	Расформировать ЦГ-Гидро, принимая во внимание, что заниматься соответствующими темами впредь будет заниматься КГ-Гидро	ГУ ИНФКОМ
8	Выработать подход к мониторингу и оценке эффективности и степени успеха КГ-Гидро и представлять доклады ИНФКОМ	ГУ ИНФКОМ

Дополнение 2 к решению 22 (ИНФКОМ-3)

[Утвержденный круг ведения включен в дополнение к [резолюции 3 \(ИНФКОМ-3\)](#)]

Решение 23 (ИНФКОМ-3)

Учреждение Исследовательской группы по вопросам оценки, назначения и обзора соответствия центров

Комиссия по наблюдениям, инфраструктуре и информационным системам,

с удовлетворением отмечая результаты и уроки, извлеченные из пилотного аудита Регионального центра Интегрированной глобальной системы наблюдений ВМО (ИГСНВ) (РЦИ) Аргентина, подробно изложенные в документе INFCOM-3/INF. 8.5(4),

отмечая далее значительные людские и финансовые ресурсы, необходимые для разработки и поддержания программы проведения аудиторской проверки и проведения такого аудита, даже в виртуальном формате,

отмечая далее существующие процессы оценки, назначения и обзора соответствия для других типов центров, находящихся в ведении ИНФКОМ, включая:

- 1) процесс назначения, оценки и повторного подтверждения РЦИ, принятый [резолюцией 12 \(ИС-73\)](#) «Процесс аудита региональных центров Интегрированной глобальной системы наблюдений ВМО»,
- 2) процесс назначения, оценки и повторного подтверждения региональных центров по приборам (РЦП), принятый [резолюцией 17 \(ИС-73\)](#) «Укрепление региональных центров по приборам», и процесс назначения, оценки и повторного подтверждения региональных центров по морским приборам, принятый [резолюцией 36 \(ИС-76\)](#) «Региональные центры по морским приборам — обновленный круг ведения, управление и процесс оценки», который включает проведение опроса Членов ВМО о региональных потребностях в обслуживании РЦМП и об использовании предлагаемого обслуживания РЦМП и удовлетворенности им, а также о финансовых проблемах, с которыми сталкиваются некоторые РЦП при получении рекомендуемой аккредитации по стандарту ИСО/МЭК 17025,
- 3) процесс аудита и сертификации центров Информационной системы ВМО (ИСВ), определенный в [Руководстве по Информационной системе ВМО](#) (ВМО-№ 1061), не обязательно гарантирует надлежащее функционирование и эксплуатацию центров,
- 4) процесс обзора соответствия, принятый [резолюцией 28 \(ИС-76\)](#) «Учреждение процесса рассмотрения соблюдения для Региональных специализированных метеорологических центров» (РСМЦ, также известные как назначенные центры Комплексной системы обработки и прогнозирования ВМО (КСОПВ)) и предусматривающий двухэтапный подход к обзору соответствия и аудиту назначенных центров КСОПВ, и значительные экспертные ресурсы, необходимые для прохождения этого процесса, выявленные в ходе обзора соответствия всех РСМЦ, осуществляющих глобальный детерминистский и ансамблевый численный прогноз погоды, проведенного Постоянным комитетом по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля (ПК-МПСЗ) в 2023 году,

признавая необходимость разработки общих принципов, касающихся процесса(ов) оценки, назначения и обзора соответствия центров, чтобы мотивировать Членов, на территории которых размещены центры ВМО, обеспечить надлежащий уровень качества выполнения функций, возложенных на каждый тип центра, в пределах допустимых людских и финансовых ресурсов, которые Члены и Секретариат ВМО смогут на устойчивой основе предоставлять в долгосрочной перспективе,

постановляет учредить Исследовательскую группу по вопросам оценки, назначения и обзора соответствия центров (ИГ-ОНОС) для разработки общих принципов, касающихся процесса(ов) оценки, назначения и обзора соответствия центров, с кругом ведения, приведенным в дополнении к настоящему решению, которое предлагается принять в качестве части дополнения к [резолюции 3 \(ИНФОМ-3\)](#).

Более подробную информацию см. в документе INFCOM-3/INF. 8.5(4).

Дополнение к решению 23 (ИНФОМ-3)

[Утвержденный круг ведения включен в дополнение к [резолюции 3 \(ИНФОМ-3\)](#)]

Решение 24 (ИНФОМ-3)

Предварительная методика оценки региональных центров Интегрированной глобальной системы наблюдений ВМО

Комиссия по наблюдениям, инфраструктуре и информационным системам,

отмечая, что многие региональные центры Интегрированной глобальной системы наблюдений ВМО (ИГСНВ) (РЦИ), созданные во всех регионах ВМО, были назначены и работают в экспериментальном режиме в течение нескольких лет и, как ожидается, будут назначены в качестве РЦИ в оперативном режиме, ожидая успешного аудита/оценки,

отмечая далее, что РЦИ Пекин и Токио были переведены в оперативный режим несколько лет назад (в 2021 г.), и эти РЦИ подлежат оценке с точки зрения их соответствия кругу ведения РЦИ,

постановляет:

- 1) одобрить следующий процесс аудита для оценки РЦИ в качестве предварительной методики до принятия решения ИНФОМ-4 по итогам работы Исследовательской группы по вопросам оценки, назначения и обзора соответствия центров (ИГ-ОНОС):
 - на основе программы проведения аудиторской проверки РЦИ, представленной в дополнении к настоящему решению и сопутствующих документах и предусматривающей, чтобы в состав групп по аудиту входили по одному аудитору и одному эксперту в предметной области (ЭПО);
 - следовать календарному плану, включающему максимум четыре аудита в год, которые будут планироваться по согласованию с Членами, принимающими и эксплуатирующими РЦИ в экспериментальном режиме, со следующей предварительной последовательностью аудитов РЦИ: (Аргентина — завершила в 2024 г.), Южная Африка (2024 г.), Марокко (2024 г.), Кения (2025 г.),

Танзания (2025 г.), Индонезия (2025 г.), Фиджи (2025 г.); РЦИ, которые будут рассмотрены для аудита на более позднем этапе: Бразилия, Британские карибские территории, Канада, Коста-Рика, Тринидад и Тобаго, США. За ними последуют РЦИ, создаваемые в Региональной ассоциации (РА) VI и в тех частях РА I, которые еще не охвачены ни одним РЦИ, в общей сложности около 20 РЦИ;

- подтвердить РЦИ Пекин и РЦИ Токио в качестве действующих региональных центров ИГСНВ до принятия решения ИНФКОМ-4 по итогам работы ИГ-ОНОС;

2) вновь подчеркнуть важность того, чтобы Члены активно сотрудничали с соответствующими РЦИ при посредстве своих национальных координаторов по Системе мониторинга качества данных ИГСНВ (СМКДИ) и в срочном порядке выдвинули или обновили свои кандидатуры в случае необходимости.

Более подробную информацию см. в документе INFCOM-3/INF. 8.5(4).

Обоснование решения:

В [резолуции 12 \(ИС-73\)](#) «Процесс аудита региональных центров Интегрированной глобальной системы наблюдений ВМО» ИНФКОМ было поручено в сотрудничестве с региональными ассоциациями продолжать развивать Процесс аудита РЦИ.

Постоянный комитет по управлению информацией и информационным технологиям (ПК-УИИТ) и Постоянный комитет по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ) при посредстве Экспертной группы по аудиту и сертификации центров (ЭГ-АС) и Экспертной группы по инструментам ИГСНВ и операциям региональных центров ИГСНВ (ЭГ-ИИ) совместно разработали программу проведения аудиторской проверки для РЦИ в соответствии со *Сборником основных документов № 2, Технический регламент* (ВМО-№ 49), том I — Общие метеорологические стандарты и рекомендуемые практики (издание 2019 г.) — часть VII. Менеджмент качества и обновленное *Руководство по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1165), глава 8. Такая программа проведения аудиторской проверки для РЦИ была предварительно одобрена членами руководства ИНФКОМ в ноябре 2023 года и использовалась для проведения пилотного аудита РЦИ Аргентина (INFCOM-3/INF. 8.5(4) содержит Отчет о проведении пилотного аудита Регионального центра ИГСНВ с уроками, извлеченными при аудите РЦИ Аргентина).

Признано, что усилия и ресурсы, затраченные на разработку и проведение процесса аудита для РЦИ, должны быть учтены при разработке и осуществлении реализуемого(ых) подхода(ов), применимого(ых) ко всем центрам.

Дополнение к решению 24 (ИНФКОМ-3)

Программа проведения аудиторской проверки региональных центров ИГСНВ

В данном документе изложена информация относительно проведении аудита региональных центров ИГСНВ (РЦИ) в целях обеспечения того, чтобы они осуществляли свою деятельность в соответствии с их кругом ведения и функциями, отвечающими потребностям Региона, и в соответствии со стандартами и руководящими принципами ВМО.

Задачи аудита	Задачи аудита РЦИ заключаются в следующем: 1. Оценить соответствие кругу ведения РЦИ 1.1 Функциональные возможности В число базовых функций РЦИ должны входить: региональная координация, управление, надзор за осуществлением и оперативной деятельностью ИГСНВ на региональном и национальном уровнях и их поддержка в качестве повседневной деятельности. Руководство по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1165) (раздел 8.3.2.1). 1.2 Обязательные функции 1. Управление региональными метаданными ИГСНВ (работа с поставщиками данных с целью содействия сбору, обновлению и улучшению качества метаданных ИГСНВ в ОСКАР/Поверхность); Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.3.2.2). 2. Региональный мониторинг, оценка эффективности работы ИГСНВ и менеджмент инцидентов (СМКДИ) и последующие меры в отношении поставщиков данных в случае проблем с наличием данных или качеством данных. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.3.2.2). 1.3 Дополнительные функции В зависимости от имеющихся ресурсов и региональных потребностей могут быть приняты одна или несколько дополнительных функций, например: а) содействие в координации региональных/субрегиональных и национальных проектов ИГСНВ; б) содействие в управлении региональными и национальными сетями наблюдений; и с) поддержка деятельности по развитию регионального потенциала. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.3.2.3). 1.4 Менеджмент инцидентов Вовлечение Членов в процесс менеджмента инцидентов на основе Технических руководящих принципов для региональных центров ИГСНВ по системе мониторинга качества данных ИГСНВ (ВМО-№ 1224) (глава 4) посредством тесного сотрудничества с РЦИ в выполнении их функций, является необходимым условием для улучшения работы станций. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.3.2.4). 1.5 Связи с другими структурами ВМО РЦИ должны работать в тесной связи как с Секретариатом ВМО (включая региональные бюро), так и с их соответствующими региональными рабочими органами, с тем чтобы обеспечивать эффективное и результативное осуществление и функционирование ИГСНВ. РЦИ должны взаимодействовать с соответствующими существующими центрами ВМО, в частности с региональными узлами телесвязи / глобальными центрами информационной системы (РУТ/ГЦИС), РЦП, региональными учебными центрами (РУЦ) и региональными климатическими центрами (РКЦ), в том, что касается всей связанной с ИГСНВ деятельности в Регионе. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.3.2.5). 2. Оценить соответствие вариантам осуществления и требованиям к обеспечению ресурсами 2.1 Варианты осуществления 2.1.1 Географический охват: а) централизованно, на общем региональном уровне, когда Член или консорциум Членов оказывают поддержку всему Региону. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.4.1) или б) на субрегиональном уровне, например в соответствии с естественными географическими или лингвистическими границами, существующими в данном Регионе. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.4.1).

2.1.2 Тип субъекта:

- а) единые субъекты (единый многофункциональный РЦИ), когда один Член берет на себя ответственность за весь набор требуемых функциональных возможностей. [Руководство по ИГСНВ](#) (ВМО-№ 1165) (раздел 8.4.1) или
- б) виртуальные/распределенные центры (сеть РЦИ), когда консорциум Членов распределяет эти обязанности между собой, возможно, под общей координацией со стороны ведущей организации. [Руководство по ИГСНВ](#) (ВМО-№ 1165) (раздел 8.4.1).

2.2 Требования к обеспечению ресурсами

2.2.1 Базовая инфраструктура

Было бы желательно, чтобы принимающая центр страна предоставила ему либо на постоянной, либо на временной основе надлежащие, безопасные, полностью оборудованные и легкодоступные помещения. Эти помещения должны быть обеспечены водо- и электроснабжением и оборудованы надежной телекоммуникационной системой. [Руководство по ИГСНВ](#) (ВМО-№ 1165) (раздел 8.4.2.1).

2.2.2 Техническая инфраструктура

Центр должен располагать надлежащим информационно-технологическим оборудованием и инфраструктурой (рабочими станциями, высокоскоростным доступом к интернету, средствами обработки и хранения данных), необходимыми для выполнения обязательных функций РЦИ. (ВМО-№ 1165, раздел 8.4.2.2).

2.3 Людские ресурсы

Необходимые людские ресурсы (управляющий, научно-технический и административный персонал) должны быть определены с точки зрения навыков и числа сотрудников (в эквиваленте полной занятости), задействованных в создании РЦИ и его функционировании. [Руководство по ИГСНВ](#) (ВМО-№ 1165) (раздел 8.4.3).

2.4 Финансовые ресурсы

Ответственность за финансирование функционирования РЦИ возлагается на участвующего(их) Члена(ов). Некоторые менее обеспеченные ресурсами Члены могут столкнуться с трудностями в изыскании необходимых средств на эксплуатацию РЦИ на национальном уровне. В подобных случаях РЦИ должны будут определить партнеров и разработать эффективные стратегии мобилизации ресурсов с целью извлечения максимального преимущества из различных многосторонних механизмов финансирования и региональных учреждений по вопросам развития. [Руководство по ИГСНВ](#) (ВМО-№ 1165) (раздел 8.4.4).

2.5 Оценка плана управления рисками с описанием каждого вида деятельности по осуществлению, включая снижение рисков

При создании РЦИ следует проанализировать основные риски, то, как они могут повлиять на деятельность РЦИ и ИГСНВ, и возможные меры по их минимизации. Уровень риска (низкий, средний, высокий) должен быть оценен для каждого типа риска. Типичными рисками являются:

- а) политические/институциональные, такие как низкий уровень политической приверженности РЦИ, снижение интереса со стороны заинтересованных кругов или смена правительства,
- б) финансовые, например, несостоятельность системы финансового управления или нехватка ресурсов,
- в) риски, связанные с людскими ресурсами, например недостаточность навыков и/или экспертных знаний; несоответствие имеющихся и необходимых опыта и особых навыков.

	Для каждого вида деятельности по осуществлению должен быть разработан план управления рисками, включая минимизацию рисков. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.5). 2.6 Оценка управления, менеджмента и исполнения Руководство РЦИ (т. е. менеджер РЦИ, руководитель РЦИ) должно осуществлять планирование и тесное взаимодействие с президентом РА, группой управления и соответствующим рабочим органом по ИГСНВ ассоциации, Секретариатом ВМО и другими связанными с ВМО структурами. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.6). 2.7 Мониторинг и оценка На менеджера РЦИ возлагается ответственность за текущее управление, координацию, мониторинг и оценку деятельности РЦИ, а также за отчетность перед исполнительным руководством организации, в рамках которой функционирует РЦИ. Он/она также несет ответственность за обновление процедур и практики, когда это необходимо. Процесс мониторинга и оценки должен демонстрировать достигнутый прогресс, выявлять риски, возникшие проблемы и трудности, а также потребность в соответствующей корректировке деятельности РЦИ. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.7). 3. Оценить соответствие принципам и задачам соответствующих этапов осуществления Регионального центра ИГСНВ (РЦИ) В этом разделе описаны три этапа осуществления РЦИ с соответствующими задачами. Предполагается, что эти три этапа будут проходить последовательно, начиная с начального этапа (период запуска), заканчивая экспериментальным этапом/режимом и последующим оперативным этапом/режимом. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.8). 3.1 Функционирование РЦИ на начальном этапе Задачи данного этапа заключаются в следующем: а) определить концепцию функционирования РЦИ и ее рамки в Регионе/субрегионе. Руководство по ИГСНВ (ВМО-№ 1165) (разделы 8.4.1 и 8.8.1); б) оформить официально намерение Члена / группы Членов разместить у себя и эксплуатировать РЦИ. Руководство по ИГСНВ (ВМО-№ 1165) (разделы 8.4.1 и 8.8.1). Члены — кандидаты на создание РЦИ должны следовать этапам 2 и 3 «Процесса назначения, оценки и повторного утверждения региональных центров Интегрированной глобальной системы наблюдений ВМО», Руководство по ИГСНВ (ВМО-№ 1165) (глава 8, дополнение 1). Типовая форма кандидата на назначение в качестве РЦИ приведена в Руководстве по ИГСНВ (ВМО-№ 1165), глава 8, дополнение 2 (раздел 8.8.1). 3.2 РЦИ, работающие на экспериментальном этапе / в экспериментальном режиме Задачи данного этапа: а) оказание помощи группе Членов, входящих в сферу ответственности РЦИ, в извлечении преимуществ из ИГСНВ; и б) создание прочной основы для перехода на последующий оперативный этап, исходя из результатов итоговой оценки. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.8.2). Ожидаемые результаты создания РЦИ на экспериментальном этапе включают оценку целесообразности последующего создания функционирующего в полном объеме РЦИ и, исходя из итоговой оценки осуществления, набор рекомендаций по ключевым аспектам такого центра, включая институциональную структуру, концепцию

	функционирования и стратегию долгосрочной устойчивости. Таким образом, экспериментальный этап должен включать в себя разработку долгосрочной стратегии финансирования, основанной, где это целесообразно, на эффективной мобилизации ресурсов. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.8.2). Экспериментальный этап начинается после успешного выполнения этапов 4 и 5 «Процесса назначения, оценки и повторного подтверждения региональных центров Интегрированной глобальной системы наблюдений ВМО» (Руководство по ИГСНВ (ВМО-№ 1165)) (глава 8, дополнение 1). В начале экспериментального этапа менеджер(ы) РЦИ обеспечивает(ют) проведение необходимой подготовительной работы и наличие механизмов осуществления в соответствии с заявкой РЦИ. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.8.2). В конце экспериментального этапа, в соответствии с шестым этапом «Процесса назначения, оценки и повторного подтверждения региональных центров Интегрированной глобальной системы наблюдений ВМО», Руководство по ИГСНВ (ВМО-№ 1165) (глава 8, дополнение 1), менеджер РЦИ подготовит и представит отчет о проделанной работе президенту РА, соответствующему региональному рабочему органу по ИГСНВ, группе управления ассоциации и Секретариату ВМО. Отчет будет содержать оценку эффективности и устойчивости результатов РЦИ, а также документальное подтверждение опыта и извлеченных уроков в соответствии с типовой формой, приведенной в Руководстве по ИГСНВ (ВМО-№ 1165), глава 8, дополнение 3 (раздел 8.8.2). 3.3 РЦИ, работающие на оперативном этапе / в оперативном режиме Задача РЦИ на данном этапе заключается в том, чтобы способствовать улучшению подлежащих международному обмену метаданных и данных наблюдений со станций наблюдений в соответствующем Регионе/субрегионе в том, что касается: a) доступности, качества и полноты метаданных (в ОСКАР/Поверхность), b) доступности данных с точки зрения частоты и регулярности их предоставления; качества данных с точки зрения их точности и полноты; и своевременности предоставления данных. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.8.3). Проверить назначение РЦИ в оперативном режиме после успешно проведенного аудита в соответствии с этапами 6 и 7 «Процесса назначения, оценки и повторного подтверждения региональных центров Интегрированной глобальной системы наблюдений ВМО», Руководство по ИГСНВ (ВМО-№ 1165) (глава 8, дополнение 1) (раздел 8.8.3). На оперативном этапе РЦИ ежегодно проходит оценку в соответствии с восьмым этапом «Процесса назначения, оценки и повторного подтверждения региональных центров Интегрированной глобальной системы наблюдений ВМО», Руководство по ИГСНВ (ВМО-№ 1165) (глава 8, дополнение 1). Повторное подтверждение назначения РЦИ в оперативном режиме основывается на результатах оценок, указанных на девятом этапе того же процесса. Руководство по ИГСНВ (ВМО-№ 1165) (раздел 8.8.3). 4. Определить соответствие системы менеджмента качества организации или ее частей Техническому регламенту (ВМО-№ 49), часть VII. Менеджмент качества, главы 1.3 и 1.4

	5. Оценить устойчивость центра с точки зрения финансирования и организационной приверженности, обязательств в отношении ресурсов и долгосрочного планирования. <i>Руководство по ИГСНВ</i> (ВМО-№ 1165) (глава 8) 6. Оценить ежемесячные отчеты о качестве работы. <i>Руководство по ИГСНВ</i> (ВМО-№ 1165) (глава 8, дополнение 1, этап 6)
Область применения аудита	Аудиты будут проводиться в соответствии со следующими документами: - Руководящие принципы, опубликованные Международной организацией по стандартизации (ИСО) в стандарте ISO 19011:2018: Руководящие указания по аудиту систем менеджмента. - <i>Исполнительный совет</i> (ВМО-№ 1277), Сокращенный окончательный отчет семьдесят третьей сессии, издание 2021 года, <i>резолюция 9 (ИС-73)</i>. - <i>Наставление по Интегрированной глобальной системе наблюдений ВМО</i> (ВМО-№ 1160). - <i>Руководство по Интегрированной глобальной системе наблюдений ВМО</i> (ВМО-№ 1165), принятое <i>резолюцией 19 (ИС-76)</i>. - <i>Технические руководящие принципы для региональных центров ИГСНВ по системе мониторинга качества данных ИГСНВ</i> (ВМО-№ 1224), издание 2018 года. - <i>Технический регламент</i> (ВМО-№ 49), том I — Общие метеорологические стандарты и рекомендуемые практики, часть VII. Менеджмент качества, главы 1.3 и 1.4. Глубина: аудиты будут проводиться на английском языке, при этом будут учитываться языковые, культурные и социальные аспекты. Места проведения: - Сертификационный аудит/оценка, <i>Руководство по ИГСНВ</i> (ВМО-№ 1165) (глава 8, дополнение 1, этап 6), для региональных центров ИГСНВ, работающих на экспериментальном этапе, будет проводиться в виртуальном режиме. Центры, неудачно прошедшие первичный сертификационный аудит/оценку, будут подвергнуты повторной оценке в очном или виртуальном режиме через 1 год. - Надзорный аудит/оценка, <i>Руководство по ИГСНВ</i> (ВМО-№ 1165) (глава 8, дополнение 1, этап 8), будет проводиться в виртуальном режиме. - Ресертификационный аудит / повторное подтверждение, <i>Руководство по ИГСНВ</i> (ВМО-№ 1165) (глава 8, дополнение 1, этап 9), будет проводиться в виртуальном режиме. Очные аудиты зависят от наличия ресурсов и финансовых средств.
Тип аудита	Аудит третьей стороной: - сертификационный и/или аттестационный аудит; - законодательно установленный, нормативный и аналогичный аудит.
Метод аудита	Выводы по аудиту будут основываться на доказательствах. Процессы аудиторской проверки, в том числе вся документация, материалы оценки объекта, дискуссии и отчетность, должны вестись на английском языке. РЦИ на экспериментальном этапе / в экспериментальном режиме - Сертификационный аудит/оценка, <i>Руководство по ИГСНВ</i> (ВМО-№ 1165) (глава 8, дополнение 1, этап 6), будет проводиться дистанционно при непосредственном взаимодействии между людьми.

	- Повторная оценка будет проводиться на объекте или дистанционно при непосредственном взаимодействии между людьми. Функционирующий РЦИ - Надзорный аудит/оценка, Руководство по ИГСНВ (ВМО-№ 1165) (глава 8, дополнение 1, этап 8), будет проводиться дистанционно при непосредственном взаимодействии между людьми. - Ресертификационный аудит / повторное подтверждение, Руководство по ИГСНВ (ВМО-№ 1165) (глава 8, дополнение 1, этап 9), будет проводиться дистанционно при непосредственном взаимодействии между людьми.
Разработка графика	Аудиты РЦИ будут спланированы на 3-летний период. Период проведения: аудит не должен длиться более двух дней без учета времени для выезда на объект проверки и возвращения с него в случае проведения аудитов на объекте. Периодичность: - Сертификационный аудит/оценка, Руководство по ИГСНВ (ВМО-№ 1165) (глава 8, дополнение 1, этап 6): не менее чем через 1 год после запуска РЦИ на экспериментальном этапе / в экспериментальном режиме (по официальному запросу Членов, Технический регламент (ВМО-№ 49), или Секретариата ВМО в адрес ПП Члена(ов), на территории которого(ых) располагаются РЦИ, работающие в экспериментальном режиме, с копией президенту РА и президенту ИНФОМ), Руководство по ИГСНВ (ВМО-№ 1165) (глава 8, дополнение 1, этап 6.2). - Надзорный аудит/оценка, Руководство по ИГСНВ (ВМО-№ 1165) (глава 8, дополнение 1, этап 8): раз в 2 года для функционирующего РЦИ. - Ресертификационный аудит / повторное подтверждение, Руководство по ИГСНВ (ВМО-№ 1165) (глава 8, дополнение 1, этап 9): раз в 4 года для функционирующего РЦИ.
Критерии аудита	К критериям аудита относятся: - Наставление по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1160). - Руководство по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1165), принятое резолюцией 19 (ИС-76). - Технические руководящие принципы для региональных центров ИГСНВ по системе мониторинга качества данных ИГСНВ (ВМО-№ 1224), издание 2018 года. - Технический регламент (ВМО-№ 49), том I — Общие метеорологические стандарты и рекомендуемые практики, часть VII. Менеджмент качества.

Риски и возможности и действия по их учету	Риски (задача ЭГ-АС — оценить риски для каждого аудита) - Планирование (неспособность установить соответствующие задачи, количество, продолжительность, места и график проведения аудитов); - ресурсы (недостаточное время, финансирование, оборудование и/или обучение для разработки программы проведения аудиторской проверки или проведения аудита); - подбор группы по аудиту (недостаточная общая компетентность для эффективного проведения аудита); - коммуникация (неэффективные внешние/внутренние каналы коммуникации); - реализация программы проведения аудиторской проверки (неэффективная координация аудитов); - контроль документированной информации (неэффективное определение необходимой документированной информации, запрашиваемой аудиторами и соответствующими заинтересованными сторонами); - неэффективный мониторинг результатов программы проведения аудиторской проверки; - доступность и сотрудничество объекта аудита и наличие доказательств, которые необходимо собрать; - ограничения, связанные с пандемией; - ограничения на поездки; - политические проблемы; - виртуальные аудиты (невозможность проверить инфраструктуру); - разные часовые пояса (аудиторы и объекты аудита); - нестабильное/плохое интернет-соединение. Возможности - Сведение к минимуму времени на дорогу и расстояний до места проведения аудита (только виртуальные аудиты); - соответствие уровня компетентности группы по аудиту уровню компетентности, необходимому для выполнения задач аудита; - согласование дат проведения аудита с доступностью аудиторов.
Группа по аудиту / аудиторы	В группу по аудиту будут входить как минимум два человека: ведущий аудитор с опытом проведения проверок и эксперт в конкретной предметной области. Технический регламент (ВМО-№ 49) (раздел 2. № 7). - Эксперты в предметных областях и Секретариат для оказания поддержки группе по аудиту / аудиторам, если это необходимо. Для обеспечения необходимой беспристрастности группы по аудиту ее состав должен быть разнообразным в региональном плане.
Соответствующая документируемая информация	- Записи, касающиеся программы проведения аудиторской проверки. - Записи, касающиеся каждого аудита. - Записи, касающиеся группы по аудиту (оценка компетентности и эффективности работы членов группы по аудиту); критерии отбора групп по аудиту и членов групп по аудиту, а также формирования групп по аудиту; поддержание и совершенствование компетентности).

Решение 25 (ИНФОМ-3)

Совместно спонсируемые программы

Комиссия по наблюдениям, инфраструктуре и информационным системам,

признавая стратегическую важность целенаправленного взаимодействия с Глобальной системой наблюдений за климатом (ГСНК) и Глобальной системой наблюдений за океаном (ГСНО), совместно спонсируемыми ВМО, Межправительственной океанографической комиссией Организации Объединенных Наций по вопросам образования, науки и культуры (МОК-ЮНЕСКО), Программой Организации Объединенных Наций по окружающей среде (ЮНЕП) и Международным научным советом (МНС) в деле продвижения подхода, основанного на системе Земля, в рамках Интегрированной глобальной системы наблюдений ВМО (ИГСНВ),

постановляет:

- 1) с признательностью принять во внимание доклады представителей ГСНК и ГСНО, представленные в документе INFCOM-3/INF. 9.1a, о состоянии сотрудничества с Комиссией, включая области, требующие улучшения;
- 2) приветствовать продолжающееся сотрудничество ГСНК и ГСНО с Комиссией, особенно успешную интеграцию сетей ГСНК и ГСНО в ИГСНВ и Информационную систему ВМО (ИСВ);
- 3) признать необходимость упорядочения связей между ГСНК, ГСНО и рабочими группами Комиссии и определить общие приоритеты и перспективное видение в отношении ГСНК, ГСНО и Членов ВМО с помощью процесса перспективного планирования;
- 4) поручить Группе управления, в рамках мандата Комиссии, работать совместно с ГСНК и ГСНО с целью выработки рекомендаций для их соответствующих органов управления:
 - a) об общих приоритетах, которые должны быть отражены в плане работы каждой структуры и рабочей структуре Комиссии;
 - b) об общем перспективном видении для ГСНК, ГСНО и Членов ВМО с целью внесения вклада в их процессы долгосрочного стратегического планирования и планирования осуществления, включая Стратегический план ВМО на 2028–2031 годы.

Обоснование решения:

[резолюция 39 \(Кг-17\)](#) «Глобальная система наблюдений за климатом»;

[резолюция 9 \(Кг-18\)](#) «Совместный совет по сотрудничеству между Всемирной метеорологической организацией и Межправительственной океанографической комиссией»;

[резолюция 47 \(Кг-18\)](#) «Наблюдения за океаном в поддержку прогнозирования системы Земля и поддержки ВМО Стратегии Глобальной системы наблюдений за океаном до 2030 года (включая Систему наблюдений в тропической зоне Тихого океана до 2020 года)»;

резолюция 28 (ИС-73) «Стратегия сотрудничества между ВМО и МОК»;

резолюция 1 (ИНФКОМ-1) «Учреждение постоянных комитетов и исследовательских групп Комиссии по наблюдениям, инфраструктуре и информационным системам (Комиссия по инфраструктуре)». (В соответствии с этой резолюцией была учреждена Совместная исследовательская группа по ГСНК в целях, в частности, обеспечения того, чтобы программа ГСНК продолжала предоставлять руководящие указания и поддержку соответствующим системам наблюдений и поддерживала подход ВМО на основе системы Земля и климатическое обслуживание);

резолюция 38 (ИС-76) «Доклад Совместной исследовательской группы по Глобальной системе наблюдений за климатом»;

резолюция 2 (ИНФКОМ-2) «Учреждение постоянных комитетов, исследовательских групп и консультативных групп Комиссии по наблюдениям, инфраструктуре и информационным системам (Комиссии по инфраструктуре)». (В соответствии с этой резолюцией была учреждена Консультативная группа по океанам (КГ-Океан)).

Решение 26 (ИНФКОМ-3)

Партнерские организации спутниковых систем

Комиссия по наблюдениям, инфраструктуре и информационным системам,

признавая ключевой вклад космических агентств, представленных в Координационной группе по метеорологическим спутникам (КГМС) и Комитете по спутниковым наблюдениям за Землей (КЕОС), в наблюдения и продукцию данных, необходимые для метеорологических, климатических, гидрологических и смежных применений ВМО в области окружающей среды,

постановляет:

- 1) с признательностью принять во внимание заявления представителей КГМС и КЕОС о состоянии их сотрудничества с Комиссией;
- 2) приветствовать выводы пятнадцатой сессии Консультативных совещаний для обсуждения политики по спутниковым вопросам на высоком уровне (КС-15, 6–7 февраля 2024 г.);
- 3) принять соответствующие меры для поддержки выводов КС-15, представленных в документе INFCOM-3/INF. 9.1b, в частности чтобы:
 - a) совместно работать над поддержкой региональных потребностей Членов в свете инициативы ООН «Заблаговременные предупреждения для всех», ускоряя выражение этих потребностей и необходимых подходов, а также поддерживая учебные мероприятия в сотрудничестве с региональными ассоциациями;
 - b) содействовать диалогу с космическими агентствами для осуществления ИСВ 2.0;
 - c) поддерживать трехсторонний диалог с космическими агентствами и представителями частного сектора по вопросам участия коммерческого сектора в связи с космическими системами наблюдений с использованием Открытой консультативной платформы;

- d) руководить взаимодействием с космическими агентствами в обновлении Перспективного видения в отношении Интегрированной глобальной системы наблюдений ВМО (ИГСНВ) в 2040 году (см. [решение 8 \(ИНФОМ-3\)](#));
- 4) поручить Группе управления ИНФОМ разработать наилучшие механизмы для продолжения тесного сотрудничества с космическими агентствами с помощью КГМС и КЕОС.

Итоги пятнадцатой сессии Консультативных совещаний для обсуждения политики по спутниковым вопросам на высоком уровне см. в документе INF.COM-3/INF. 9.1b.

Обоснование решения: [резолюция 62 \(Кг-19\)](#) «Обзор ранее принятых резолюций Конгресса» вместе с решением о поддержании Космической программы для координации совместно с космическими агентствами деятельности Членов по обеспечению устойчивых и совместимых спутниковых наблюдений, активизации наращивания потенциала и продвижения спутниковой продукции и применений.

Решение 27 (ИНФОМ-3)

Другие координационные механизмы ООН

Комиссия по наблюдениям, инфраструктуре и информационным системам,

ссылаясь на [резолюцию 4 \(Кг-Внеоч.\(2021\)\)](#) «Перспективное видение и Стратегия ВМО в области гидрологии и соответствующий План действий»,

приветствуя участие ВМО в Инициативе по комплексному мониторингу для достижения цели 6 в области устойчивого развития — чистая вода и санитария — и ее вклад в эту инициативу,

отмечая деятельность Механизма «ООН — водные ресурсы», его членов и партнеров в рамках [Общесистемной стратегии Организации Объединенных Наций \(ООН\) в области водоснабжения и санитарии](#), в частности результат 4.2 «Высококачественные дезагрегированные данные и информация о воде и санитарии доступны и прозрачно распространяются через укрепленные национальные и субнациональные системы мониторинга и региональные и глобальные платформы при поддержке системы ООН», призывающий структуры ООН поддержать страны в укреплении национальных систем мониторинга для сбора, анализа и представления данных, связанных с водой и санитарией, уделяя особое внимание пространственной разбивке данных по бассейнам и улучшению совместимости данных, а также разработке международных стандартов,

признавая плодотворное продолжающееся сотрудничество с учреждениями ООН, как на двусторонней основе, например, с Организацией Объединенных Наций по вопросам образования, науки и культуры (ЮНЕСКО) и Европейской экономической комиссией Организации Объединенных Наций (ЕЭК ООН), так и на многосторонней основе через координационный механизм, предоставляемый Механизмом «ООН — водные ресурсы»,

признавая далее необходимость укрепления сотрудничества и координации с другими соответствующими подразделениями и партнерами ООН в поддержку реализации общесистемной стратегии ООН в области водоснабжения и санитарии, направленной на решение гидрологических проблем, имеющих отношение к Комиссии, в частности, на сбор и распространение данных,

постановляет через свои соответствующие вспомогательные органы и в соответствии с Планом действий в области гидрологии содействовать осуществлению общесистемной стратегии ООН в области водоснабжения и санитарии путем более активного участия в программах развития потенциала в области измерения, мониторинга, анализа и управления данными в целях улучшения национальных систем гидрологического мониторинга.

Обоснование решения: Генеральная Ассамблея ООН в резолюции RES/77/334 «Последующие действия в связи с Конференцией Организации Объединенных Наций по среднесрочному всеобъемлющему обзору хода достижения целей Международного десятилетия действий „Вода для устойчивого развития“, 2018—2028 годы» просила Генерального секретаря ООН представить в консультации с государствами-членами до конца семьдесят восьмой сессии Генеральной Ассамблеи общесистемную стратегию ООН в области водоснабжения и санитарии в целях усиления координации и реализации приоритетов в области водных ресурсов в рамках всей системы ООН и в этом контексте уделить особое внимание связанным с водой потребностям развивающихся стран, включая потребности, касающиеся финансирования, передачи технологий и создания потенциала. Механизм «ООН — водные ресурсы» разработал общесистемную стратегию ООН в области водоснабжения и санитарии в консультации с государствами-членами. Стратегия была утверждена Комитетом высокого уровня по программам (КВУП) 12 марта 2024 года. Для того чтобы стратегия была эффективной, она должна учитываться в связанных с водными ресурсами решениях членами Механизма «ООН — водные ресурсы», включая ВМО.

Решение 28 (ИНФОМ-3)

Развитие потенциала

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

(Координационный механизм в рамках ИНФОМ)

- 1) одобрить созданный механизм координации деятельности по развитию потенциала между группами ИНФОМ, уделяя особое внимание мероприятиям, способствующим реализации инициативы «Заблаговременные предупреждения для всех» и Глобальной службы наблюдения за парниковыми газами
- 2) применять этот механизм для координации деятельности по развитию потенциала под руководством ИНФОМ, в том числе, в частности, указанную в пунктах ниже, используя в качестве общего руководства Рамочную основу ВМО для развития потенциала, принятую в [резолюции 36 \(Кг-19\)](#) «Стратегия ВМО в области развития потенциала»;
- 3) одобрить создание [информационной панели материалов по развитию потенциала](#) для улучшения доступа к существующим материалам по развитию потенциала и учебным материалам, а также продолжать ее развитие и поддержание функционирования;

(Система компетенций)

- 4) провести в сотрудничестве с региональными бюро обзор существующей системы компетенций (часть V [Технического регламента](#) (ВМО-№ 49), том I — Общие

метеорологические стандарты и рекомендуемые практики, и *Compendium of WMO Competency Frameworks* (Сборник систем компетенций ВМО) (WMO-No. 1209)) и в координации с Группой экспертов по развитию потенциала (ГЭРП) оценить нужды и потребности и в случае необходимости составить план по обновлению существующих и разработке новых систем компетенции;

- а) отмечая текущие усилия Постоянного комитета по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП) по сопоставлению существующих руководящих указаний и учебных материалов с необходимыми компетенциями и выявлению потенциальных пробелов (как представлено в разделе А документа INFCOM-3/INF. 10), призвать другие группы использовать этот опыт;

(Планирование и проведение учебных мероприятий)

- 5) с удовлетворением одобрить учебные мероприятия, организованные в межсессионный период с октября 2022 года (как представлено в разделе В документа INFCOM-3/INF. 10), и план учебных мероприятий на следующий межсессионный период (как представлено в разделе С документа INFCOM-3/INF. 10) и поручить Группе управления в координации с ГЭРП и региональными рабочими группами при поддержке региональных бюро оказать поддержку в осуществлении данного плана;
- 6) отметить поддержку осуществлению Глобальной опорной сети наблюдений (ГОСН) через Фонд финансирования систематических наблюдений (ФФСН), о которой сообщается в документе INFCOM-3/INF. 8.1(4), и рекомендовать Постоянному комитету по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ), ПК-ИПП и Постоянному комитету по управлению информацией и информационным технологиям (ПК-УИИТ) поддерживать возможности развития потенциала, созданные ФФСН, посредством деятельности их региональных центров, учебных материалов и мероприятий, в контексте роли ВМО как технического органа для ФФСН;
- 7) содействовать применению подхода на основе системы Земля в любых мероприятиях по развитию потенциала путем включения областей/дисциплин системы Земля, особенно океанов, гидрологии, криосферы, состава атмосферы и космической погоды, а также путем расширения сотрудничества между региональными центрами ВМО и другими органами, занимающимися областями/дисциплинами системы Земля (например, региональными альянсами Глобальной системы наблюдений за океаном (ГСНО));
- 8) изучить возможность интеграции вклада социальных и гуманитарных областей/дисциплин и полностью признать меж- и трансдисциплинарные усилия, связанные с развитием потенциала в целом;
- 9) поощрять связанные с ИНФКОМ региональные центры (например, региональные центры Интегрированной глобальной системы наблюдений ВМО (ИГСНВ) (РЦИ), региональные центры по приборам (РЦП), региональные центры по морским приборам (РЦМП), мировые и региональные радиационные центры (МРЦ и РРЦ), ведущие центры измерений (ВЦИ), центры Информационной системы ВМО (ИСВ), центры Комплексной системы обработки и прогнозирования ВМО (КСОПВ)) к сотрудничеству с региональными учебными центрами (РУЦ) ВМО при поддержке региональных бюро в разработке и проведении учебных мероприятий для достижения долгосрочных целей и стратегических задач ВМО;
 - а) отмечая текущие усилия ПК-СНСМ, разработать рамочную основу подготовки кадров для ИГСНВ, главным образом в области ГОСН и существующих инструментов ИГСНВ (как представлено в разделе D документа INFCOM-3/INF. 10), в качестве справочного документа для любых

мероприятий по развитию потенциала, касающихся этой области, и поощрять другие группы к использованию этого опыта;

- b) определить и мобилизовать существующие возможности и ресурсы в области образования и профессиональной подготовки и в случае необходимости изыскивать возможности расширения сети назначенных центров;
- 10) изучить инновационные способы, включая использование машинного перевода, для обеспечения доступности учебных ресурсов на всех официальных языках Организации Объединенных Наций, а также содействовать использованию существующих инструкций для перевода, например инструкций, разработанных [Центром переводческих ресурсов КОМЕТ](#), для облегчения подготовки учебных материалов на нескольких языках;
- 11) координировать действия с инициативами «Глобальный кампус ВМО» и КОНЕКТ при посредничестве ГЭРП для развития и мобилизации возможностей и ресурсов в области образования и подготовки кадров, развивать партнерские отношения и использовать вспомогательные технологии для совместных проектов по развитию потенциала, а также содействовать обмену ресурсами между учреждениями с использованием, в соответствующих случаях, совместимых технологических средств;

(Организация технической конференции (ТЕКО), с участием частных и государственных секторов)

- 12) отмечая план проведения ТЕКО в 2024 году (с 23 по 26 сентября 2024 г. в Вене, Австрия), продолжать регулярную, раз в два года, организацию технических конференций ВМО по метеорологическим и экологическим приборам и методам наблюдений (ТЕКО) как прекрасную возможность для развития потенциала, включая взаимовыгодное партнерство с частным сектором.

Более подробную информацию см. в документе INFCOM-3/INF. 10.

Обоснование решения: [резолюция 36 \(Кг-19\)](#) «Стратегия ВМО в области развития потенциала (СВРП)», [резолюция 37 \(Кг-19\)](#) «Образование и подготовка кадров» и [резолюция 38 \(Кг-19\)](#) «Другие вопросы, касающиеся развития потенциала», которые способствуют применению положений СВРП в рамках усилий по развитию потенциала в ИНФКОМ и которые содержат поручение об оказании поддержки разработке и проведению мероприятий по образованию и подготовке кадров. [Решение 4 \(ИС-76\)](#) «Рекомендации Группы по развитию потенциала», которое способствует развитию континуума исследований и оперативной деятельности.

Примечание: настоящее решение заменяет [решение 20 \(ИНФКОМ-2\)](#) «Развитие потенциала», которое более не имеет силы.

Решение 29 (ИНФКОМ-3)

Гендерное равенство

Комиссия по наблюдениям, инфраструктуре и информационным системам,

ссылаясь на [резолюцию 39 \(Кг-19\)](#) «План действий ВМО по гендерным вопросам на девятнадцатый финансовый период»,

отмечая проблему достижения гендерного баланса среди должностных лиц и экспертов Комиссии (доля женщин среди экспертов, работающих во вспомогательных органах Комиссии составляет 24 %, доля женщин, занимающих руководящие должности, составляет 29 %),

признавая тот факт, что достижение Комиссией цели по обеспечению гендерного равенства зависит от дальнейших усилий Членов, направленных на обеспечение гендерного баланса при выдвижении кандидатур экспертов,

порукает Группе управления при поддержке Секретариата в качестве вклада Комиссии в План действий ВМО по гендерным вопросам на 2024—2027 годы принять меры в трех областях:

- 1) продолжить организацию *кружков ИНФКОМ* как средства поддержания и постепенного расширения сети женщин-экспертов, участвующих в работе Комиссии (вклад в выполнение пункта 1.1.3 Плана ВМО по гендерным вопросам на 2024—2027 гг.);
- 2) предоставлять примеры уникального вклада и выдающихся достижений женщин, работающих в Комиссии, в качестве материалов для Бюллетеня ВМО, издания *MeteoWorld* и других материалов для коммуникации, регулярно выпускаемых и посвященных гендерным вопросам (5.1.1);
- 3) установить простые индикаторы для мониторинга прогресса в деле улучшения гендерного баланса среди экспертов, как работающих во вспомогательных органах, так и занимающих руководящие должности в Комиссии (2.4.1);

порукает президенту при поддержке Секретариата поддерживать связь с президентом Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды и председателем Совета по исследованиям для регулярного обмена информацией об усилиях, предпринимаемых для содействия выполнению Плана действий ВМО по гендерным вопросам, и применения полученного опыта;

настоятельно призывает Членов прилагать постоянные усилия для регистрации большего числа женщин-экспертов в Сети экспертов, ссылаясь на просьбу, высказанную в циркулярном письме 01543/2024/I/Technical Experts от 16 февраля 2024 года.

Обоснование решения: организованы кружки ИНФКОМ:

- в декабре 2023 года на тему «Как быть истинным лидером и работать с полной самоотдачей?», который посетили 19 человек;
- в феврале 2024 года на тему «Как сделать так, чтобы настойчивость работала на вас?», который посетили 55 человек;
- в марте 2024 года на тему «Как получить признание на работе, которого вы заслуживаете?», который посетили 44 человека.

Примечание: настоящее решение заменяет [решение 21 \(ИНФКОМ-2\)](#), которое более не имеет силы.

Решение 30 (ИНФОМ-3)

Метод голосования для избрания должностных лиц

Комиссия по наблюдениям, инфраструктуре и информационным системам,
учитывая решение 24 (СЕРКОМ-3) «Выборы должностных лиц СЕРКОМ»,
учитывая далее рекомендацию 11 (СЕРКОМ-3) «Выборы должностных лиц СЕРКОМ»,
принимает в качестве метода голосования для избрания должностных лиц на текущей сессии голосование очно и по доверенности.

Обоснование решения: приложение VI к [Правилам процедуры для технических комиссий](#) (ВМО-№ 1240).

Решение 31 (ИНФОМ-3)

Выборы должностных лиц

Комиссия по наблюдениям, инфраструктуре и информационным системам:

- 1) **избрала** Мишеля Жана (Канада) президентом Комиссии;
- 2) **избрала** Паквай Чаня (Гонконг, Китай) со-вице-президентом Комиссии;
- 3) **избрала** Яна Даньгельку (Чехия) со-вице-президентом Комиссии;
- 4) **избрала** Паскаля Ваниху (Объединенная Республика Танзания) со-вице-президентом Комиссии.

Обоснование решения: [статья 19 с\)](#) Конвенции, [правила 10 и 62—72](#) Общего регламента ([Сборник основных документов № 1](#) (ВМО-№ 15, издание 2023 г.), [правила 3.1, 6.13.1 к\)](#) и [6.17.3](#) [Правил процедуры технических комиссий](#) (ВМО-№ 1240, издание 2023 г.).

Решение 32 (ИНФОМ-3)

Исполняющий обязанности президента

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет, что в случае если президент Комиссии уходит в отставку или не может или не имеет права выполнять свои обязанности, связанные с этой должностью, Ян Даньгелька (Чехия) должен исполнять обязанности президента в соответствии с [правилом 11 Общего регламента](#) ([Сборник основных документов № 1](#) (ВМО-№ 15)).

Обоснование решения: [правило 11](#) *Общего регламента (Сборник основных документов № 1 (ВМО-№ 15))* и [правило 3.8](#) *Правил процедуры для технических комиссий (ВМО-№ 1240)*.

Решение 33 (ИНФОМ-3)

Принятие во внимание Исполнительным советом методов голосования для избрания должностных лиц технических комиссий

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет согласиться с рекомендацией 11 (СЕРКОМ-3) «Выборы должностных лиц СЕРКОМ», в которой Исполнительному совету рекомендуется включить методы голосования для избрания должностных лиц технических комиссий в круг ведения Целевой группы по выборам и назначениям (ЦГ-ВН).

Более подробную информацию см. в документе SERCOM-3/Doc. 10.

Обоснование решения: [резолуция 7 \(ИС-77\)](#) «Вспомогательные органы Исполнительного совета», [правило 6.18.4](#) *Правил процедуры для технических комиссий (ВМО-№ 1240)* и [приложение VI](#) к ним.

Решение 34 (ИНФОМ-3)

Дата и место проведения следующих сессий ИНФОМ

Комиссия по наблюдениям, инфраструктуре и информационным системам постановляет:

- 1) провести свою четвертую сессию (ИНФОМ-4) в принципе в 2026 году в штаб-квартире ВМО в Женеве, Швейцария;
 - 2) поручить Группе управления Комиссии в консультации с Группой управления Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ), другими органами и Генеральным секретарем принять решение о точных сроках проведения ИНФОМ-4, чтобы обеспечить оптимальное представление рекомендаций Конгрессу и Исполнительному совету;
 - 3) предложить Членам рассмотреть возможность проведения ИНФОМ-4 в своей стране в соответствии с [правилом 17](#) *Общего регламента*.
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Обоснование решения: [резолуция 48 \(Кг-19\)](#), в которой проведение ИНФОМ-4 запланировано на апрель 2026 года; все положения *Общего регламента*, изложенные в [Сборнике основных документов № 1](#) (ВМО-№ 15, издание 2023 г.) и касающиеся сессий конституционных органов (правила [17—47](#) *Общего регламента*), применяются к межправительственному сегменту сессий технических комиссий. Согласно [правилу 6.1](#) *Правил процедуры для технических комиссий* (ВМО-№ 1240, издание 2023 г.), очередные сессии технических комиссий, как правило, следует проводить с интервалом не более двух лет.

ПРИЛОЖЕНИЕ 4. РЕКОМЕНДАЦИИ, ПРИНЯТЫЕ СЕССИЕЙ

Рекомендация 1 (ИНФОМ-3)

Расширенная Программа Всемирной службы погоды и связанная с ней программа

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 16 \(Кг-V\)](#) «Всемирная служба погоды», которой был утвержден план Всемирной службы погоды как один из основных пунктов программы деятельности ВМО на пятый финансовый период, в ответ на решения различных органов Организации Объединенных Наций по вопросу о международном сотрудничестве в использовании космического пространства в мирных целях и, в частности, решения 1721(XVI) и 1802(XVII) Генеральной Ассамблеи Организации Объединенных Наций,
- 2) [резолюцию 62 \(Кг-19\)](#) «Обзор ранее принятых резолюций Конгресса», которая устанавливает программную структуру ВМО на девятнадцатый финансовый период, сохраняет ее элементы и поручает Комиссии по инфраструктуре:
 - a) разработать расширенную программу, как результат эволюции программы Всемирной службы погоды, охватывающую потребности в области инфраструктуры с целью охвата всей системы Земля в соответствии со Стратегическим планом, и представить ее Исполнительному совету на его семьдесят восьмой сессии и
 - b) разработать и обновить описания программ, которые подлежат сохранению, в свете реформы системы управления, Стратегического плана и других происходящих изменений, и представить их Исполнительному совету на его семьдесят восьмой сессии,

вновь подтверждая убеждение, выраженное в [резолюции 16 \(Кг-V\)](#), что если возможности, предоставляемые современными научными и техническими разработками, будут использоваться и применяться согласованным образом на глобальной основе, то это обеспечит огромные преимущества всем странам мира, развитым и развивающимся, и что такие возможности должны использоваться только в мирных целях с должным учетом национального суверенитета и безопасности государств, в соответствии с положениями Устава Организации Объединенных Наций, а также в соответствии с духом и традициями ВМО,

подтверждая, что расширенная Программа Всемирной службы погоды и связанные с ней программы и партнерства, находящиеся в ведении Комиссии по инфраструктуре, являются базовой организационной основой для научно-технической деятельности по развитию и совершенствованию оперативной инфраструктуры, которая является основой для всех видов деятельности и областей применений ВМО,

отмечая, что этап подготовки к эксплуатации Глобальной службы криосферы (ГСК) успешно завершен, о чем сообщается в документе INFCOM-3/INF. 5, и ГСК была интегрирована в расширенную Программу Всемирной службы погоды,

изучив проект описания расширенной Программы Всемирной службы погоды и связанной с ней Космической программы, представленный в дополнении к настоящей рекомендации,

рекомендует Исполнительному совету утвердить описание расширенной Программы Всемирной службы погоды как одной из основных программ ВМО и связанной с ней Космической программы, приведенное в дополнении к настоящей рекомендации, в рамках проекта резолюции 4.2/1 (ИС-78) об утверждении основных программ ВМО на девятнадцатый финансовый период.

Дополнение к рекомендации 1 (ИНФОМ-3)

Дополнение 2 к проекту резолюции 4.2/1 (ИС-78)

Расширенная Программа Всемирной службы погоды

1. Цель и сфера охвата

1.1 Опираясь на наследие Программы Всемирной службы погоды, которая была основана ВМО в 1963 году в ответ на резолюцию Генеральной Ассамблеи Организации Объединенных Наций 1961 года, и согласно преамбуле Конвенции ВМО, «признавая важность комплексной международной системы наблюдений, сбора, обработки и распространения метеорологических, гидрологических и связанных с ними данных и продукции» и ее статье 2 (a), (b), (c) и (e), цель расширенной Программы Всемирной службы погоды заключается в разработке и внедрении глобально скоординированных компонентных систем: Интегрированной глобальной системы наблюдений ВМО (ИГСНВ), Информационной системы ВМО (ИСВ) и Комплексной системы обработки и прогнозирования ВМО (КСОПВ) для сбора, обработки, передачи и распространения данных наблюдений системы Земля и соответствующих стандартов; в разработке и внедрении рациональных методов управления данными и информацией для всех программ ВМО и связанных с ними областей применений и обслуживания; а также в координации проведения и применения результатов стандартных анализов и прогнозов по моделям.

1.2 Сфера охвата программы определяется в двух направлениях:

- 1) поддержка областей применений, включая их пользователей, которые необходимо учитывать при определении требований к компонентным системам и потребности в них:
 - a) погода и применения, связанные с погодой;
 - b) климат, включая климатическое обслуживание, а также вклад в Глобальную систему наблюдений за климатом (ГСНК) и со стороны ГСНК;
 - c) применения, связанные с водой;
 - d) обслуживание, связанное с окружающей средой, в частности, применения, связанные с составом атмосферы, и обслуживание в области космической погоды.
- 2) области системы Земля, в которых/в интересах которых функционируют компонентные системы:
 - a) атмосфера — как физика в качестве центрального оперативного компонента ВМО, опирающегося на наследие Программы Всемирной службы погоды и Программы по приборам и методам наблюдений, так и химия (химический состав) благодаря активному взаимодействию с оперативными и исследовательскими сообществами в рамках Глобальной службы атмосферы (ГСА) и Глобальной службы наблюдения за парниковыми газами (ГСНПГ);

- b) гидрология за счет активного взаимодействия с гидрологическими организациями Членов, руководствуясь *Перспективным видением, Стратегией и соответствующим Планом действий в области гидрологии и Стратегией гидрологических исследований ВМО* (ВМО-№ 1319);
- c) криосфера за счет активного взаимодействия с оперативными и исследовательскими программами и организациями через ГСК;
- d) океан, в тесном сотрудничестве с Межправительственной океанографической комиссией Организации Объединенных Наций по вопросам образования, науки и культуры (МОК/ЮНЕСКО), в том числе через Совместный совет по сотрудничеству между ВМО и МОК (ССС), и включая вклад в Глобальную систему наблюдений за океаном (ГСНО) и со стороны ГСНО, руководствуясь Стратегией Глобальной системы наблюдений за океаном до 2030 года и Стратегией сотрудничества между ВМО и МОК на 2022—2025 годы;
- e) земная поверхность/поверхность суши, не охваченные гидрологией и криосферой;
- f) космическая погода.

1.3 В областях системы Земля, не относящихся к атмосфере, исполнители компонентов расширенной Программы Всемирной службы погоды часто находятся вне национальных метеорологических и гидрологических служб (НМГС), что для достижения успеха требует поддержания и развития партнерских отношений на международном, региональном и национальном уровнях.

1.4 Программа включает деятельность по содействию программам приземных и аэрологических метеорологических наблюдений и других наблюдений системы Земля в районах всеобщего достояния: в космосе (через связанную Космическую программу), в открытом море и в Антарктике в сотрудничестве с соответствующими международными организациями, а также разработку и осуществление антарктической региональной практики и содействие обмену и распространению антарктических данных для оперативных и исследовательских целей, как это вытекает из [статьи 2 Конвенции](#).

2. Общая задача

2.1 Будучи подкреплена Единой политикой ВМО в области международного обмена данными о системе Земля ([резолюция 1 \(Кг-Внеоч.\(2021\)\)](#)), общая цель расширенной Программы Всемирной службы погоды заключается в том, чтобы обеспечить достижение к 2030 году следующих долгосрочных результатов:

- a) интегрированная система сетей наблюдений за системой Земля для целей, указанных в п. 1.2.1, включая атмосферу, гидрологию, океан, криосферу, состав атмосферы и космическую погоду, становится все более автоматизированной и оптимизированной для обеспечения эффективного и устойчивого глобального охвата;
- b) высококачественные, соответствующие целевому назначению и отслеживаемые данные измерений и прогнозов всех компонентов системы Земля поступают в непрерывный, бесплатный и неограниченный глобальный обмен данными, отвечающий Единой политике ВМО в области данных и поддерживаемый стандартизированными механизмами управления и обмена данными;
- c) предоставление все более актуальной, надежной и прошедшей контроль качества продукции численного анализа и прогнозирования системы Земля для того, чтобы Члены могли предоставлять необходимое обслуживание.

2.2 Программа непосредственно решает стратегические задачи 2.1, 2.2 и 2.3 Стратегического плана ВМО на 2024—2027 годы в качестве глобальной инфраструктуры, поддерживающей все программы ВМО и их соответствующие области применений и обслуживания, а также исследовательскую деятельность:

- а) стратегическая задача 2.1. Оптимизировать сбор данных наблюдений системы Земля через Интегрированную глобальную систему наблюдений ВМО (ИГСНВ);
- б) стратегическая задача 2.2. Улучшить и расширить доступ, обмен и управление данными текущих и прошлых наблюдений системы Земля и полученной на их основе продукцией через Информационную систему ВМО;
- в) стратегическая задача 2.3. Способствовать доступу и использованию продукции численного анализа и прогнозирования системы Земля во всех временных и пространственных масштабах, получаемой благодаря КСОПВ.

3. Основные программные компоненты

На рисунке 1 показаны компонентные системы расширенной Всемирной службы погоды.

Программный компонент, направленный на решение стратегической задачи 2.1: Интегрированная глобальная система наблюдений ВМО (ИГСНВ)

Цель и сфера охвата

3.1 В соответствии со статьей 2 (а) Конвенции ВМО (*Сборник основных документов № 1* (ВМО-№ 15)), которая гласит, что одной из основных целей Организации является «облегчать всемирное сотрудничество в создании сетей станций, производящих метеорологические наблюдения, а также гидрологические и других геофизические наблюдения, относящиеся к метеорологии», ИГСНВ в качестве рамочной основы для всех систем наблюдений ВМО и для вклада ВМО в совместно спонсируемые системы наблюдений в поддержку всех программ и видов деятельности ВМО¹, предоставляет Членам стандарты, принципы и инструменты, которые оптимизируют сбор и облегчают использование наблюдений из систем, которые принадлежат различным организациям и программам, управляются и эксплуатируются ими.

3.2 В соответствии со статьей 2 (с) Конвенции ВМО (*Сборник основных документов № 1* (ВМО № 15)), которая гласит, что одной из основных целей Организации является «содействовать стандартизации метеорологических и других соответствующих наблюдений и обеспечивать единообразное издание данных наблюдений и статистических данных», ИГСНВ также предоставляет Членам стандарты, принципы и инструменты в том, что касается сбора и публикации информации о качестве измеряемых величин при поддержке измерений, приборного оснащения и прослеживаемости.

3.3 Сфера охвата ИГСНВ соответствует сфере охвата расширенной программы Всемирной службы погоды с дополнительным направлением, касающимся наземных (как земных, так и океанических) и космических систем, которые являются частями общей системы, способствующими удовлетворению требований определенных областей применений. Координация космического компонента осуществляется через связанную Космическую программу.

¹ Совместно спонсируемыми системами наблюдений являются Глобальная система наблюдений за климатом (ГСНК) и Глобальная система наблюдений за океаном (ГСНО), которые были созданы ВМО совместно с Межправительственной океанографической комиссией (МОК) Организации Объединенных Наций по вопросам образования, науки и культуры (ЮНЕСКО), Программой ООН по окружающей среде (ЮНЕП) и Международным научным советом (МНС).

Основная долгосрочная задача

3.4 Основная долгосрочная задача этого программного компонента заключается в оптимизации сбора данных наблюдений системы Земля через ИГСНВ (СЗ 2.1), руководствуясь [Перспективным видением в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году](#) (ВМО-№ 1243) и [резолюцией 20 \(Кг-19\)](#) «Руководящие указания высокого уровня по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение в отношении ИГСНВ в 2040 году».

Деятельность по осуществлению

3.5 В следующих пунктах представлен обзор распределения обязанностей по осуществлению деятельности в рамках данного программного компонента, как это определено в [Наставлении по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160), главы 1 и 2.

Деятельность, которая будет осуществляться Членами ВМО

- Внедрение операторами сетей наблюдений, станций и платформ
- Эксплуатация и обслуживание наблюдательных систем, включая устранение недостатков и аудит
- Управление качеством наблюдений
- Предоставление наблюдений и метаданных наблюдений
- Добровольная поддержка глобальной и региональной инфраструктуры и центров в поддержку менеджмента качества ИГСНВ
- Поддержание и развитие взаимовыгодных отношений на национальном уровне для привлечения партнеров (других министерств или научных организаций), занимающихся вопросами координации устойчивой инфраструктуры наблюдений в областях системы Земля
- Поддержка развития потенциала других Членов

Деятельность, которая будет осуществляться Комиссией по инфраструктуре (ИНФКОМ)

- Определение потребностей пользователей к ИГСНВ на основании консультаций с пользователями
- Разработка, планирование и эволюция ИГСНВ
- Разработка и документирование стандартов и рекомендаций для систем и сетей наблюдений
- Активная поддержка в вопросе защиты необходимого радиочастотного спектра (через связанную Космическую программу)
- Мониторинг эффективности и соответствия
- Обеспечение обратной связи от пользователей и обзор потребностей
- Поддержка развития потенциала

- Поддержание и развитие взаимовыгодных отношений на национальном уровне для привлечения партнерских организаций и систем наблюдений (т. е. учреждений ООН и научных организаций, занимающихся вопросами координации устойчивой инфраструктуры наблюдений в конкретных областях системы Земля, космических агентств)

Деятельность, которая будет осуществляться Комиссией по обслуживанию (СЕРКОМ)

- Предоставление ИНФКОМ информации о потребностях пользователей в наблюдениях с упором на то, где именно наблюдения оказывают наибольшее воздействие (в сотрудничестве с КСОПВ, по мере необходимости)
- Предоставление ИНФКОМ обратной связи от пользователей и обзора эффективности функционирования ИГСНВ, потребностей в наблюдениях и руководящих указаний

Деятельность, которая будет осуществляться Советом по исследованиям (СИ)

- Предоставление ИНФКОМ информации о потребностях пользователей в наблюдениях с упором на то, где именно наблюдения оказывают наибольшее воздействие
- Предоставление ИНФКОМ обратной связи от пользователей и обзора эффективности функционирования ИГСНВ, потребностей в наблюдениях и руководящих указаний
- Поддержание диалога с ИНФКОМ по вопросам, касающимся возможностей и потребностей в инновациях в области наблюдений

Деятельность, которая будет осуществляться региональными ассоциациями (РА)

- Предоставление ИНФКОМ информации о потребностях пользователей и разработке сетей наблюдений для региональных приоритетов
- Предоставление рекомендаций в отношении региональных центров в поддержку ИГСНВ
- Развитие партнерств с соответствующими региональными органами в поддержку осуществления ИГСНВ
- Поддержка развития потенциала Членов, в том числе путем выявления пробелов и поддержания связей с региональными центрами по вопросам планирования и осуществления деятельности в области развития потенциала

Деятельность, которая будет осуществляться Секретариатом

В дополнение к общей роли Секретариата, определенной в [Сборнике основных документов № 1](#) (ВМО-№ 15):

- Поддержка Стратегического плана ВМО на 2024—2027 годы, стратегическая задача 2.1, а также поддержка программы работы ИНФКОМ и ее ролей, определенных выше, и ее связей с другими элементами Стратегического плана ВМО
- Поддержание связей с другими органами ВМО, указанными выше, в связи с их ролью в осуществлении ИГСНВ
- Поддержка совместно с Членами разработки и обслуживания инструментов для сбора и хранения информации о состоянии ИГСНВ, а также о мониторинге хода ее осуществления, эффективности и соответствия
- Поддержка Членов в форме предоставления информации и руководящих указаний по вопросам осуществления ИГСНВ

- Поддержка развития потенциала Членов
- Поддержка в области установления и поддержания взаимовыгодных отношений с соответствующими партнерскими организациями
- Представление интересов ВМО в качестве технического органа в Руководящем комитете Фонда финансирования систематических наблюдений (ФФСН) и предоставление информации о стандартах сети наблюдений и результатах мониторинга соответствия, а также обеспечение взаимодействия между ФФСН и ИНФКОМ

Программный компонент, направленный на решение стратегической задачи 2.2: Информационная система ВМО (ИСВ)

Цель и сфера охвата

3.6 В соответствии со статьей 2 (b) Конвенции ВМО (*Сборник основных документов № 1* (ВМО-№ 15)), которая гласит, что одной из основных целей Организации является «содействие созданию и поддержанию систем быстрого обмена метеорологической и другой соответствующей информацией», ИСВ обеспечивает гибкую и расширяемую структуру управления данными и передачи данных, которая должна использоваться для сбора и обмена информацией в отношении всех программ ВМО и связанных с ними международных программ.

3.7 Сфера охвата ИСВ соответствует сфере охвата расширенной Программы Всемирной службы погоды и предполагает предоставление общих решений для обмена данными и управления данными в различных масштабах.

Основная долгосрочная задача

3.8 Основная долгосрочная задача этого программного компонента заключается в улучшении и расширении доступа, обмена и управления данными текущих и прошлых наблюдений системы Земля и полученной на их основе продукцией через ИСВ (СЗ 2.2) в соответствии со Стратегией и Планом осуществления ИСВ 2, внося при этом вклад в аспекты обмена и управления данными в рамках *Перспективного видения и Плана действий ВМО в области гидрологии*.

Деятельность по осуществлению

3.9 В следующих пунктах представлен обзор распределения обязанностей по осуществлению деятельности в рамках данного программного компонента на основании *Наставления по Информационной системе ВМО* (ВМО-№ 1060).

Деятельность, которая будет осуществляться Членами ВМО

- Осуществление и эксплуатация национального компонента ИСВ для выполнения Членами своих обязанностей по обмену данными ВМО, включая устранение недостатков и аудит
- Обеспечение соблюдения технических стандартов ВМО в отношении данных и метаданных в их системах управления данными
- Добровольная поддержка глобальных центров и центров сбора или подготовки данных в поддержку ИСВ
- Информирование ВМО о ходе осуществления ИСВ, соблюдении/несоблюдении технического регламента ИСВ

- Поддержка развития потенциала других Членов
- Поддержание и развитие взаимовыгодных отношений на национальном уровне для привлечения партнеров (других министерств или научных организаций), занимающихся вопросами координации соответствующих систем передачи и обработки данных

Деятельность, которая будет осуществляться ИНФКОМ

- Определение потребностей пользователей в ИСВ на основании консультаций с пользователями
- Разработка, планирование и эволюция ИСВ
- Разработка и документирование стандартов и рекомендаций для системы обмена данными, управления данными и метаданными
- Мониторинг эффективности и соответствия
- Обеспечение обратной связи от пользователей и обзор потребностей
- Поддержка развития потенциала
- Поддержание и развитие взаимовыгодных отношений на международном уровне для привлечения партнерских организаций (т. е. ООН и научных организаций, занимающихся вопросами координации систем передачи и обработки данных)

Деятельность, которая будет осуществляться СЕРКОМ

- Предоставление ИНФКОМ информации о потребностях пользователей в отношении типов и объема данных наблюдений и обработанных данных для глобального обмена, а также в отношении уровня обслуживания в области обмена данными
- Предоставление ИНФКОМ информации о потребностях пользователей в отношении стандартизации данных и метаданных
- Предоставление ИНФКОМ обратной связи от пользователей и обзора эффективности функционирования ИСВ

Деятельность, которая будет осуществляться СИ

- Предоставление ИНФКОМ информации о потребностях пользователей в отношении данных наблюдений и обработанных данных для глобального обмена, а также в отношении уровня обслуживания в области обмена данными
- Предоставление ИНФКОМ обратной связи от пользователей и обзора эффективности функционирования ИСВ
- Поддержание диалога с ИНФКОМ по вопросам, касающимся возможностей и потребностей в инновациях в области систем передачи и обработки данных

Деятельность, которая будет осуществляться РА

- Предоставление ИНФКОМ информации о потребностях пользователей в обмене данными, стандартах данных и метаданных, обратной связи от пользователей и обзора эффективности функционирования ИСВ

- Предоставление ИНФКОМ информации о потребностях пользователей и разработке систем обмена данными, стандартов данных и метаданных для региональных приоритетов
- Рекомендации в отношении глобальных центров и центров сбора и подготовки данных в поддержку ИСВ
- Развитие партнерств с соответствующими региональными органами в поддержку осуществления ИСВ
- Поддержка развития потенциала Членов, в том числе путем выявления пробелов и поддержания связей с региональными центрами по вопросам планирования и осуществления деятельности в области развития потенциала

Деятельность, которая будет осуществляться Секретариатом

В дополнение к общей роли Секретариата, определенной в [Сборнике основных документов № 1](#) (ВМО-№ 15):

- Поддержка Стратегического плана ВМО на 2024—2027 годы, стратегическая задача 2.2, а также поддержка программы работы ИНФКОМ и ее ролей, определенных выше, а также ее связей с другими элементами Стратегического плана ВМО
- Поддержание связей с другими органами ВМО, указанными выше, в связи с их ролью в осуществлении ИСВ
- Поддержка совместно с Членами разработки и обслуживания инструментов для сбора и хранения информации о состоянии ИСВ, а также о мониторинге хода ее осуществления, эффективности и соответствия
- Поддержка Членов в форме предоставления информации и руководящих указаний по вопросам осуществления ИСВ
- Поддержка развития потенциала Членов
- Поддержка в области установления и поддержания взаимовыгодных отношений с соответствующими партнерскими организациями

Программный компонент, направленный на решение стратегической задачи 2.3: Комплексная система обработки и прогнозирования ВМО (КСОПВ)

Цель и сфера охвата

3.10 В соответствии с преамбулой Конвенции ВМО, «признавая важность комплексной международной системы наблюдений, сбора, обработки и распространения метеорологических, гидрологических и связанных с ними данных и продукции» и ее статьями 2 (а) и (с) ([Сборник основных документов № 1](#) (ВМО-№ 15)), в которых заявляется, среди целей Организации, «{...}содействовать учреждению и поддержке центров, в обязанности которых входит предоставление метеорологического и других видов обслуживания» и «{...} обеспечивать единообразное издание данных наблюдений и статистических данных», соответственно, КСОПВ обеспечивает Членам ВМО и другим международным организациям возможность доступа и использования актуальной, надежной и прошедшей контроль качества продукции численного анализа и прогнозирования системы Земля, более совершенных прогнозов, рекомендаций, предупреждений и специализированной прогностической продукции во всех временных и пространственных масштабах на основе самых современных науки и технологии. КСОПВ представляет собой всемирную сеть оперативных центров, управляемых Членами ВМО и

другими международными организациями, которые производят продукцию численного анализа и прогнозирования системы Земля, прогнозы, рекомендации и ориентировочные прогнозы, предупреждения и специализированную прогностическую продукцию, необходимые Членам ВМО и соответствующим оперативным организациям для предоставления обслуживания, а также для исследовательской деятельности. Эти виды обслуживания включают в себя защиту жизни и имущества, повышение безопасности на суше, на море и в воздухе, улучшение качества жизни, устойчивое развитие и защиту окружающей среды в рамках программы ВМО и других международных программ.

3.11 Сфера охвата КСОПВ соответствует сфере охвата расширенной Программы Всемирной службы погоды и направлена на бесперебойное предоставление всей необходимой продукции анализа и прогнозирования в разных пространственных и временных масштабах и для всех областей применений и областей системы Земля.

Основная долгосрочная задача

3.12 Основная долгосрочная задача этого программного компонента заключается в производстве, обеспечении доступа и использования высококачественной продукции численного анализа и прогнозирования системы Земля во всех временных и пространственных масштабах (СЗ 2.3) с учетом трех основных направлений деятельности и ключевых приоритетов — система и обслуживание, исследования и инновации и доступность, — определенных в рамках *Структуры сотрудничества КСОПВ* ([резолюция 58 \(Кг-18\)](#) и [резолюция 26 \(Кг-19\)](#)).

Деятельность по осуществлению

3.13 В следующих пунктах представлен обзор распределения обязанностей по осуществлению деятельности в рамках данного программного компонента на основе [Наставления по Глобальной системе обработки данных и прогнозирования](#) (ВМО-№ 485), части I и II.

Деятельность, которая будет осуществляться Членами ВМО

- Выполнение функций КСОПВ в соответствии с национальными и международными требованиями, включая добровольное участие в эксплуатации и обслуживании назначенных центров КСОПВ:
 - a) контроль качества поступающих данных наблюдений;
 - b) сбор данных и распространение продукции;
 - c) долговременное хранение данных и продукции;
 - d) верификация продукции и эффективность функционирования;
 - e) документация по системам и продукции;
 - f) обучение и профессиональная подготовка;
 - g) отчетность о соответствии;
 - h) графическое представление данных, анализов и прогнозов;
 - i) анализ и прогнозирование, включая использование и предоставление продукции анализа и прогнозирования КСОПВ назначенными центрами КСОПВ
- Поддержка КСОПВ путем использования и предоставления обратной связи в отношении анализов и прогнозов назначенных центров КСОПВ

- Поддержание и развитие взаимовыгодных отношений на национальном уровне для привлечения партнеров (других министерств или научных организаций, занимающихся вопросами координации устойчивой инфраструктуры моделирования в областях/дисциплинах системы Земля)
- Поддержка развития потенциала других Членов

Деятельность, которая будет осуществляться ИНФКОМ

- Определение потребностей пользователей в КСОПВ на основании консультаций с пользователями
- Разработка, планирование и эволюция КСОПВ
- Разработка и документирование стандартов и рекомендаций для систем обработки и прогнозирования в рамках областей применений и/или областей и дисциплин системы Земля
- Мониторинг эффективности и соответствия
- Обеспечение обратной связи от пользователей и обзор потребностей
- Поддержка развития потенциала
- Поддержание и развитие взаимовыгодных отношений на международном уровне для привлечения соответствующих партнерских организаций

Деятельность, которая будет осуществляться СЕРКОМ

- Предоставление ИНФКОМ информации о потребностях пользователей в отношении продукции и обслуживания КСОПВ на основании консультаций с пользователями
- Предоставление ИНФКОМ обратной связи от пользователей и обзора эффективности функционирования КСОПВ, потребностей в продукции и руководящих указаний
- Сотрудничество с ИНФКОМ в вопросах внесения изменений в технические спецификации деятельности, назначения центров и контроля за соблюдением требований

Деятельность, которая будет осуществляться СИ

- Предоставление ИНФКОМ информации о потребностях пользователей в продукции КСОПВ
- Предоставление ИНФКОМ обратной связи от пользователей и обзора эффективности функционирования КСОПВ, потребностей в продукции и руководящих указаний
- Содействие продвижению науки и технологий в поддержку совершенствования и эволюции КСОПВ
- Поддержание диалога с ИНФКОМ по вопросам, касающимся возможностей и потребностей в инновациях в области бесшовного прогнозирования

Деятельность, которая будет осуществляться РА

- Предоставление ИНФКОМ информации о потребностях пользователей в отношении продукции и обслуживания КСОПВ для региональных приоритетов

- Определение региональных потребностей в продукции и обслуживании КСОПВ и разработка оптимального развертывания назначенных центров КСОПВ
- Развитие партнерств с соответствующими региональными органами в поддержку осуществления КСОПВ
- Поддержка развития потенциала Членов, в том числе путем выявления пробелов и поддержания связей с региональными центрами по вопросам планирования и осуществления деятельности в области развития потенциала

Деятельность, которая будет осуществляться Секретариатом

В дополнение к общей роли Секретариата, определенной в [Сборнике основных документов № 1](#) (ВМО-№ 15):

- Поддержка Стратегического плана ВМО на 2024—2027 годы, стратегическая задача 2.3, а также поддержка программы работы ИНФКОМ и ее ролей, определенных выше, а также ее связей с другими элементами Стратегического плана ВМО
- Поддержание связей с другими органами ВМО, указанными выше, в связи с их ролью в осуществлении КСОПВ
- Взаимодействие с соответствующими международными организациями для поддержания взаимовыгодных отношений, необходимых для КСОПВ
- Поддержка совместно с Членами разработки и обслуживания инструментов для сбора и хранения информации о состоянии КСОПВ, а также о мониторинге хода ее осуществления, эффективности и соответствия
- Поддержка Членов в форме предоставления информации и руководящих указаний по вопросам осуществления КСОПВ
- Поддержка развития потенциала Членов

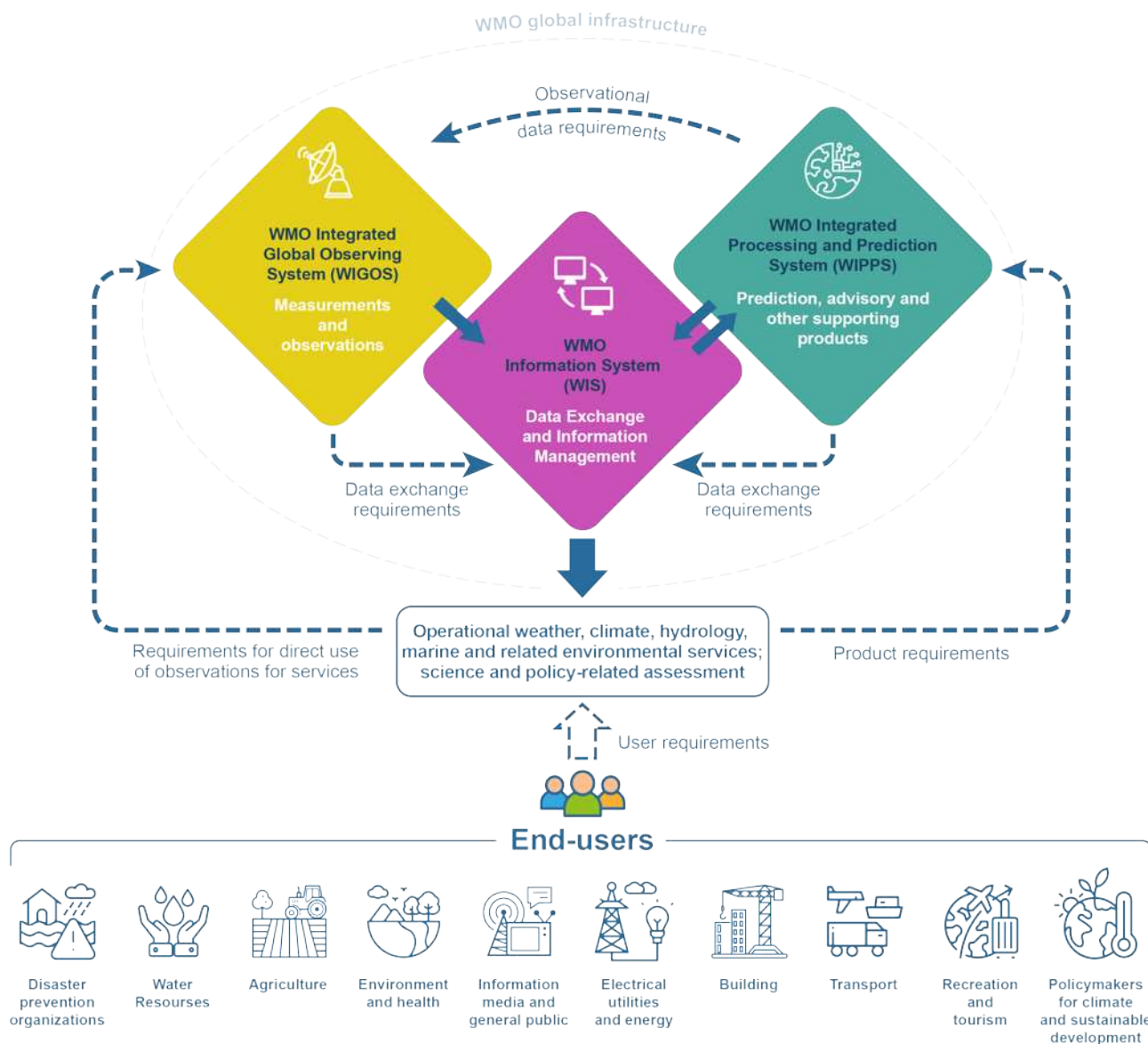


Рисунок 1. Компонентные системы расширенной Всемирной службы погоды: Интегрированная глобальная система наблюдений ВМО, Информационная система ВМО и Комплексная система обработки и прогнозирования ВМО (глобальная инфраструктура ВМО), их взаимосвязь и отношения с пользователями

Космическая программа

Цель и сфера охвата

4.1 Цель Космической программы ВМО заключается в координации совместно с космическими агентствами деятельности участников по обеспечению устойчивых и совместимых спутниковых наблюдений, укрепления потенциала и продвижения спутниковой продукции и применений². Она содействует обеспечению широкого доступа к спутниковым данным и продукции и их использованию для всех соответствующих областей применений и областей системы Земля, а также интеграции всех компонентов, необходимых для предоставления оперативного обслуживания в рамках соответствующих процессов и рамочных программ ВМО. В частности, Космическая программа ВМО координирует развитие космической системы наблюдений в целях полного осуществления

² Эта цель была определена в [резолюции 62 \(Кг-19\)](#).

Перспективного видения в отношении Интегрированной глобальной системы

наблюдений ВМО в 2040 году (ВМО-№ 1243), признавая взаимодополняющий характер космического и наземного компонентов ИГСНВ, их индивидуальные преимущества и ограничения, а также потенциал для интеграции. Она содействует проведению взаимной калибровки спутниковых приборов и гармонизации их спецификаций. Она поощряет космические агентства, занимающиеся оперативными вопросами и НИОКР, вносить вклад в ИГСНВ во всех областях системы Земля и привести систему в соответствие с передовой практикой.

4.2 Спутниковые агентства представляют собой специализированное сообщество по осуществлению, действующее в интересах всеобщего достояния, но способное предоставлять критически важные наблюдения и продукцию, основанную на полученных данных, полезные для глобальной инфраструктуры расширенной Программы Всемирной службы погоды, и, следовательно, создающие ценность для всех Членов ВМО. Благодаря партнерству с эксплуатационными организациями спутниковой связи в рамках Координационной группы по метеорологическим спутникам (КГМС) и Комитета по спутниковым наблюдениям за Землей (КЕОС) Космическая программа ВМО следит за (текущими и планируемыми) возможностями в области космических наблюдений и анализирует пробелы в отношении меняющихся потребностей. Она поддерживает глобальное планирование, оптимизацию и координацию компонента космической системы наблюдений ИГСНВ и рекомендует переходить к использованию новых технологий на оперативном уровне для удовлетворения потребностей всех областей применений, восполняя пробелы во всех областях системы Земля.

4.3 Сфера охвата: координировать деятельность и вопросы, связанные со спутниками, в рамках других программ ВМО и давать руководящие указания в отношении потенциала космических наблюдений.

Основные долгосрочные задачи

4.4 Основная долгосрочная задача Космической программы соответствует расширенной Программе Всемирной службы погоды и, в частности, заключается в оптимизации сбора данных наблюдений системы Земля через ИГСНВ (СЗ 2.1), руководствуясь *Перспективным видением в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году* (ВМО-№ 1243).

Деятельность по осуществлению

4.5 Деятельность в рамках Космической программы ВМО осуществляется по пяти основным направлениям:

- 1) Интегрированная космическая система наблюдений: координация разработки космического компонента ИГСНВ для всех областей применений и областей системы Земля
- 2) Доступность и использование спутниковых данных и продукции: расширение своевременного доступа к спутниковым данным и продукции, необходимым пользователям во всех регионах ВМО, содействие осуществлению ИСВ и КСОПВ
- 3) Наращивание потенциала и привлечение пользователей: максимальное использование и преимущества спутниковых данных для Членов ВМО
- 4) Координация инфраструктуры космической погоды: в рамках ИГСНВ, ИСВ и КСОПВ
- 5) Координация использования радиочастотного спектра: активная поддержка в вопросе защиты необходимых полос частот для расширенной Программы Всемирной службы погоды в тесном сотрудничестве с Сектором радиосвязи Международного союза электросвязи (МСЭ-R) и Членами ВМО

4.6 Космическая программа играет важную роль в определении потребностей Членов в отношении космических агентств. Конкретные роли космических агентств Членов, ИНФКОМ, СЕРКОМ, других конституционных органов ВМО и Секретариата соответствуют ролям, описанным выше в компонентах расширенной Программы Всемирной службы погоды.

Рекомендация 2 (ИНФКОМ-3)

План действий по вкладу ИНФКОМ в осуществление инициативы «Заблаговременные предупреждения для всех» (ЗПДВ)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 4 \(Кг-19\)](#) «Инициатива Организации Объединенных Наций „Заблаговременные предупреждения для всех“»,
- 2) [резолюцию 1 \(ИС-77\)](#) «Вклад ВМО в инициативу „Заблаговременные предупреждения для всех“»,
- 3) [резолюцию 7 \(ИС-77\)](#) «Вспомогательные органы Исполнительного совета»,

отмечая замечания и комментарии Членов в отношении перечня приоритетных опасных явлений и видов деятельности, которые свидетельствуют о настоятельной потребности в укреплении инфраструктуры мониторинга и прогнозирования опасных явлений,

рассмотрев план действий по четырем направлениям деятельности в области содействия инициативе ЗПДВ, разработанный Целевой группой по ЗПДВ,

рекомендует Исполнительному совету утвердить план действий посредством проекта резолюции, приведенного в дополнении к настоящей рекомендации.

Дополнение к рекомендации 2 (ИНФКОМ-3)

Проект резолюции №№/1 (ИС-78)

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на:

- 1) [резолюцию 4 \(Кг-19\)](#) «Инициатива Организации объединенных Наций „Заблаговременные предупреждения для всех“», в которой содержится поручение техническим комиссиям:
 - а) определять приоритетные виды деятельности по удовлетворению насущных потребностей Членов при создании эффективных систем заблаговременных предупреждений о многих опасных явлениях (СЗПМОЯ) и включать их в их соответствующие планы работы на следующий финансовый период,

- b) выявлять, каталогизировать и интегрировать приоритетные возникающие опасные явления, такие как опасные явления, связанные с изменениями в криосфере, в поддержку разработки необходимых систем мониторинга и заблаговременных предупреждений для затрагиваемых этими явлениями Членов,
 - c) осуществлять приоритетные виды деятельности на основе сотрудничества, скоординированным и согласованным образом и регулярно докладывать Исполнительному совету,
- 2) [резолюцию 1 \(ИС-77\)](#) «Вклад ВМО в инициативу „Заблаговременные предупреждения для всех“», в которой региональным ассоциациям (РА), техническим комиссиям и Совету по исследованиям (СИ) поручается под руководством Исполнительного совета консолидировать все свои соответствующие мероприятия под эгидой ЗПДВ и доложить Совету,
- 3) [резолюцию 7 \(ИС-77\)](#) «Вспомогательные органы Исполнительного совета», в которой роль координации технических органов Организации (технических комиссий, СИ и других соответствующих органов) и РА делегируется Техническому координационному комитету (ТКК),

рассмотрев рекомендацию 2 (ИНФКОМ-3) «План действий по вкладу ИНФКОМ в осуществление инициативы „Заблаговременные предупреждения для всех“ (ЗПДВ)»

согласившись с [рекомендацией 2 \(ИНФКОМ-3\)](#),

одобряет план действий в отношении компонентов инфраструктуры, способствующих осуществлению инициативы ЗПДВ, представленный в дополнении к настоящей резолюции и состоящий из планов работы, касающихся:

- 1) рассмотрения потребностей пользователей и пробелов в наблюдениях для целей ЗПДВ посредством Региональной опорной сети наблюдений (РОСН);
- 2) устранения пробелов в спутниковых данных/продукции;
- 3) анализа пробелов и совершенствования продукции Комплексной системы обработки и прогнозирования ВМО (КСОПВ) для приоритетных опасных явлений;
- 4) рассмотрения возникающих опасных явлений, связанных с криосферой и требующих скоординированных действий со стороны РА, технических комиссий и СИ, в качестве вспомогательного материала для координации между этими органами;

предлагает Членам внести свой вклад в осуществление действий через постоянные комитеты, исследовательские группы, рабочие и экспертные группы РА, технические комиссии и СИ;

порукает:

- 1) региональным ассоциациям возглавить работу по выполнению задач, поставленных перед РА в плане действий;
 - 2) Комиссии по инфраструктуре руководить техническим аспектом плана действий;
 - 3) Комиссии по обслуживанию и Совету по исследованиям поддержать работу по выполнению соответствующих задач, предусмотренных планом действий;
 - 4) Техническому координационному комитету осуществлять контроль и координацию выполнения плана действий и регулярно докладывать о ходе его выполнения Исполнительному совету.
-

Дополнение к резолюции №№/1 (ИС-78)

План действий в отношении компонентов инфраструктуры, способствующих осуществлению инициативы ЗПДВ

Примечание: задачи, выделенные желтым цветом, предполагают наличие руководящих указаний высокого уровня, за которые отвечают ИНФКОМ и Секретариат, а задачи, выделенные синим цветом, предполагают региональное участие.

Таблица 1. Проект плана работы по рассмотрению потребностей пользователей и пробелов в наблюдениях для целей ЗПДВ посредством РОСН

Условные обозначения:

ОП	области применений	РОСН	Региональная опорная сеть наблюдений
ЗПДВ	Заблаговременные предупреждения для всех	Doc.	документ
ГУ	Группа управления	ОСКАР	Инструмент анализа и обзора возможностей систем наблюдений
ОЭГ-ПЭСНЗ	Объединенная экспертная группа по проектированию и эволюции систем наблюдений за Землей	РГ/И	Рабочая группа по инфраструктуре
КПСЗ	Категория применений системы Земля	ЭГ	экспертная группа
ЗРП	Заявление о руководящих принципах	РА	Региональная ассоциация
ИГСНВ	Интегрированная глобальная система наблюдений ВМО	НК	национальный координатор
ИНФКОМ	Комиссия по наблюдениям, инфраструктуре и информационным системам	РЦИ	региональные центры ИГСНВ

№	Задачи	Формат (наставление, руководство, шаблон, руководящие принципы)	Представить в (орган, например ИНФОМ-3)	Срок исполнения	Ответственный орган (группа, Секретариат, контактное лицо и т. д.)	Консультации и поддержка (группа, Секретариат, контактное лицо и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Комментарии	Состояние
1.1	Идентификация ОП в соответствии с приоритетными опасными явлениями для целей ЗПДВ	Аналитический документ	ГУ ИНФОМ через ОЭГ-ПЭСНЗ	15 ноября 2023 г.	Подгруппа ОЭГ-ПЭСНЗ по ЗПДВ	Контактные лица	Виртуальные совещания		Частично завершено . Аналитический документ был представлен на совещании ГУ ИНФОМ — Т14
1.2	Руководящие принципы, описывающие порядок отображения и обоснование, для координаторов КПСЗ и контактных лиц по ОП	Таблица с руководящими принципами	ГУ ИНФОМ через ОЭГ-ПЭСНЗ	30 июня 2024 г.	Подгруппа ОЭГ-ПЭСНЗ по ЗПДВ	Секретариат	Виртуальные совещания		В процессе выполнения
1.3	Обновление шаблона ЗРП для лучшего отражения пробелов в наблюдениях с целью обеспечения надлежащей связи ОП с опасными явлениями по каждой КПСЗ	Шаблон ЗРП	ГУ ИНФОМ через ОЭГ-ПЭСНЗ	30 ноября 2023 г.	Подгруппа ОЭГ-ПЭСНЗ по ЗПДВ	Секретариат	Работа Секретариата		Завершено. Шаблон ЗРП был соответствующим образом обновлен
1.4	Обновление Наставления по ИГСНВ	Наставление	ИНФОМ-3	30 ноября 2023 г.	Подгруппа ОЭГ-ПЭСНЗ по ЗПДВ	Секретариат	Виртуальные совещания	Обновление технического регламента РОСН	Проект обновлений включен в документ INFCOM-3/Doc 8.1(1) для обсуждения

№	Задачи	Формат (наставление, руководство, шаблон, руководящие принципы)	Представить в (орган, например ИНФОМ-3)	Срок исполнения	Ответственный орган (группа, Секретариат, контактное лицо и т. д.)	Консультации и поддержка (группа, Секретариат, контактное лицо и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Комментарии	Состояние
1.5	Обновление Руководства по ИГСНВ	Руководство	ИНФОМ-3	30 ноября 2023 г.	Подгруппа ОЭГ-ПЭСНЗ по ЗПДВ	Секретариат	Виртуальные совещания	Обновление перечня проблем РОСН	Проект обновлений включен в документ INFCOM-3/Doc 8.1(2) для обсуждения
1.6	Определение приоритетности потребностей в ОСКАР/Потребности с учетом приоритетных опасных явлений для целей ЗПДВ и типичных проблем РОСН	База данных ОСКАР/Потребности	ОЭГ-ПЭСНЗ	31 августа 2024 г.	Контактные лица по ОП и ответственные за ОП	Секретариат	Консультации контактных лиц по ОП с экспертами КСОПВ и соответствующими группами		В процессе выполнения
1.7	Анализ пробелов по данной ОП с учетом приоритетности потребностей в ОСКАР/Потребности в соответствии с приоритетными опасными явлениями для целей ЗПДВ и типичными проблемами РОСН	Таблица для ЗРП	Ответственный за КПСЗ через координатора КПСЗ	30 ноября 2024 г.	Контактные лица по ОП и ответственные за ОП	Подгруппа ОЭГ-ПЭСНЗ по ЗПДВ	Консультации контактных лиц по ОП с экспертами КСОПВ и соответствующими группами		В процессе выполнения
1.8	ЗРП по всем ОП для каждой КПСЗ	ЗРП	ГУ ИНФОМ	31 марта 2025 г.	Координаторы КПСЗ	ОЭГ-ПЭСНЗ	Практические семинары, виртуальные встречи		В процессе выполнения

№	Задачи	Формат (наставление, руководство, шаблон, руководящие принципы)	Представить в (орган, например ИНФОМ-3)	Срок исполнения	Ответственный орган (группа, Секретариат, контактное лицо и т. д.)	Консультации и поддержка (группа, Секретариат, контактное лицо и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Комментарии	Состояние
2.1	Обновление Оперативного плана РА	Оперативный план	ГУ РА	30 сентября 2024 г.	РГ/И	Секретариат (штаб-квартира и региональные бюро)	Работа Секретариата		В процессе выполнения
2.2	Перечень приоритетных опасных явлений на национальном уровне	Краткий информационны й документ с перечнем	ГУ РА	30 июня 2024 г.	РГ/И и Секретариат (штаб-квартира и региональные бюро)	Члены ВМО	Практические семинары и опросы по мере необходимости		Завершено в отдельных РА (например, РА II, РА VI)
2.3	Определение приоритетных опасных явлений для всего региона на основе перечня национальных приоритетов (если позволяют ресурсы, то на уровне субрегионов)	Краткий документ с отображением и перечнем опасных явлений	ГУ РА	30 июня 2024 г.	Службы РГ/И и РГ РА и/или их конкретная экспертная группа	Секретариат (региональные бюро)	Работа Секретариата		Завершено в отдельных РА (например, РА II, Ra IV , RA V, RA VI)

№	Задачи	Формат (наставление, руководство, шаблон, руководящие принципы)	Представить в (орган, например ИНФОМ-3)	Срок исполнения	Ответственный орган (группа, Секретариат, контактное лицо и т. д.)	Консультации и поддержка (группа, Секретариат, контактное лицо и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Комментарии	Состояние
2.4	Определение требований к наблюдениям (необходимые переменные и критерии) в регионе (если позволяют ресурсы, то на уровне субрегионов) и приоритетного опасного явления, а также обобщение наиболее строгих требований по всем рассматриваемым опасным явлениям	Таблица типов систем наблюдения с указанием в каждом случае перечня наблюдаемых переменных, цикла наблюдения и пространственно-временного разрешения	ГУ РА	31 марта 2025 г.	РГ/И РА	Секретариат (региональные бюро и штаб-квартира), контактные лица по ОП и ОЭГ-ПЭСНЗ по мере необходимости	Практические семинары, виртуальные совещания, работа Секретариата	Руководящие принципы, предоставляемые ОЭГ-ПЭСНЗ в качестве эталонных для определения ключевых переменных и их требований по отношению к необходимым ОП будут определены (соотносятся с задачами 1.6 выше)	
2.5	Сбор информации о существующих возможностях наблюдений у каждого Члена ВМО на основе требующихся наблюдений	Перечень станций наблюдений с указанием местоположения, измеряемых переменных и цикла наблюдений		30 июня 2025 г.	Секретариат (региональные бюро и штаб-квартира)	НК ИГСНВ, РЦИ	Работа Секретариата при возможной поддержке консультанта		

№	Задачи	Формат (наставление, руководство, шаблон, руководящие принципы)	Представить в (орган, например ИНФОМ-3)	Срок исполнения	Ответственный орган (группа, Секретариат, контактное лицо и т. д.)	Консультации и поддержка (группа, Секретариат, контактное лицо и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Комментарии	Состояние
2.6	Анализ пробелов РОСН в регионе (если позволяют ресурсы, то на уровне субрегионов) и рассматриваемые опасные явления	Таблицы	ИНФОМ, РА	30 июня 2025 г.	РГ/И РА и соответствующие ЭГ	Секретариат (региональные бюро и штаб-квартира), ОЭГ-ПЭСНЗ	Работа Секретариата при возможной поддержке консультанта	Сопоставление потребностей пользователей с возможностями системы наблюдений (соотносится с задачами 1.7 выше)	
2.7	Перечень станций в каждом регионе/субрегионе	Таблица с перечнем станций	РА	31 декабря 2025 г.	РГ/И РА и соответствующие ЭГ	Секретариат (региональные бюро и штаб-квартира)	Работа Секретариата при возможной поддержке консультанта		
2.8	Среднесрочный план развития РОСН в каждом регионе/субрегионе в целях дальнейшего устранения пробелов	План осуществления	РА	31 декабря 2025 г.	РГ/И РА и соответствующие ЭГ	Секретариат (региональные бюро и штаб-квартира)	Работа Секретариата при возможной поддержке консультанта		

Таблица 2. Проект плана работы по устранению пробелов в спутниковых данных/продукции в поддержку инициативы ЗПДВ

Условные обозначения:

СЗП	Система заблаговременных предупреждений	ЭГ-КСИ	Экспертная группа по космическим системам и их использованию
ГУ	Группа управления		

№	Задачи	Представить в (орган, например ИНФОМ-3)	Ответственный орган (группа, Секретариат и т. д.)	Консультации и поддержка (Секретариат и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Примерные сроки исполнения	Комментарии	Состояние
1.1	Подготовка обследования по вопросу использования спутниковых данных для СЗП		РА (например, региональные координационные группы по удовлетворению потребностей в спутниковых данных)	Секретариат (региональные бюро, отдел КСИ) под руководством ЭГ-КСИ	Виртуальные совещания, обмен электронной почтой, работа Секретариата	Июль 2024 г.		
1.2	Проведение обследования среди Членов		РА	Секретариат (региональные бюро)	Динамичное обследование	Сентябрь 2024 г.		
1.3	Анализ пробелов с точки зрения доступа к спутниковым данным, обучения в области обработки, визуализации и использования спутниковых данных и продукции	ГУ ИНФОМ и ГУ РА через региональные координационные группы по удовлетворению потребностей в спутниковых данных	Региональные координационные группы по удовлетворению потребностей в спутниковых данных, при поддержке ЭГ-КСИ	Секретариат (региональные бюро, отдел КСИ) под руководством ЭГ-КСИ	Виртуальные совещания, обмен электронной почтой, работа Секретариата	Март 2025 г.		

№	Задачи	Представить в (орган, например ИНФОМ-3)	Ответственный орган (группа, Секретариат и т. д.)	Консультации и поддержка (Секретариат и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Примерные сроки исполнения	Комментарии	Состояние
1.4	Определение минимального (по регионам) набора спутниковой продукции, требующейся для осуществления инициативы ЗПДВ	ГУ ИНФОМ и ГУ РА через региональные координационные группы по удовлетворению потребностей в спутниковых данных	Региональные координационные группы по удовлетворению потребностей в спутниковых данных, при поддержке ЭГ-КСИ	Секретариат (региональные бюро, отдел КСИ) под руководством ЭГ-КСИ	Виртуальные совещания, обмен электронной почтой, работа Секретариата	Июль 2025 г.		
1.5	Разработка региональных планов осуществления по устранению пробелов, выявленных в ходе анализа пробелов, которые будут включены в региональные ОП	РА	РА	Секретариат (региональные бюро, отдел КСИ) под руководством ЭГ-КСИ	Виртуальные совещания, обмен электронной почтой, работа Секретариата	Будут определены РА		

Таблица 3. Проект плана работы по анализу пробелов и совершенствованию продукции КСОПВ для приоритетных опасных явлений

Условные обозначения:

РСМЦ	региональные специализированные метеорологические центры	ЕЦСПП	Европейский центр среднесрочных прогнозов погоды
ПК-МПСЗ	Постоянный комитет по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля	НАСА	Национальное управление по аэронавтике и исследованию космического пространства
ППСП	Программа прогнозирования явлений суровой погоды	ЧПП	численное прогнозирование погоды
HQ	штаб-квартира	ГСОДП	Глобальная система обработки данных и прогнозирования
РА	региональная ассоциация	ММЦ	практический семинар Мировых метеорологических центров
СИ	Совет по исследованиям	ИГ-БИД	Исследовательская группа по будущей инфраструктуре данных
ИИ	искусственный интеллект	ПК-УИИТ	Постоянный комитет по управлению информацией и информационным технологиям
РСГЦ	региональные специализированные гидрологические центры	СИ	Совет по исследованиям
СЕРКОМ	Комиссия по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды	РОП	регулярный обзор потребностей
СОРВБП	Система оценки риска возникновения быстроразвивающихся паводков с глобальным охватом	ГЭРП	Группа экспертов по развитию потенциала
ГидроСОП	Глобальная система ВМО для оценки текущей гидрологической ситуации и ее ориентировочного прогнозирования	РУЦ	региональные учебные центры
КСОПВ	Комплексная система обработки и прогнозирования ВМО	РКЦ	региональные климатические центры
ИНФКОМ	Комиссия по наблюдениям, инфраструктуре и информационным системам		

№	Задачи	Представить в (орган, например ИНФОМ-3)	Ответственный орган (группа, Секретариат и т. д.)	Консультации и поддержка (Секретариат и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Примерные сроки исполнения	Комментарии	Состояние
1.1	Определение потенциальных РСМЦ для ЧПП по ограниченному району	ИНФОМ-4	РА	Консультации с Членами, ИНФОМ/ПК-МПСЗ, ППСР. Поддержка со стороны Секретариата (штаб-квартира и региональные бюро)	Совещания, поддержка со стороны Секретариата	Апрель 2026 г.	По возможности расположение в месте нахождения региональных центров ППСР	Инициировано в РА I
1.2	Определение потенциальных РСМЦ для наукастинга	ИНФОМ-4	ИНФОМ	Консультации с Членами, включая космические агентства, РА, СИ. Поддержка со стороны Секретариата (штаб-квартира и региональные бюро)	Совещания, пилотные проекты, поддержка со стороны Секретариата	Апрель 2026 г.	Работа с пилотными проектами по наукастингу	Пилотный проект по наукастингу на основе ИИ, инициированный Членами
1.3	Определение потенциальных РСГЦ	ИНФОМ-4	РА и региональные советники по гидрологии	Консультации с Членами, ИНФОМ, СЕРКОМ. Поддержка со стороны Секретариата (штаб-квартира и региональные бюро)	Совещания, поддержка со стороны Секретариата	Апрель 2026 г.	Работа с инициативами ВМО (СОРВБП, ГидроСОП)	ВМО обратилась к Членам, располагающим РСГЦ

№	Задачи	Представить в (орган, например ИНФОМ-3)	Ответственный орган (группа, Секретариат и т. д.)	Консультации и поддержка (Секретариат и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Примерные сроки исполнения	Комментарии	Состояние
1.4	Создание и назначение РСГЦ для глобального прогнозирования речных паводков	ИНФОМ-4	ИНФОМ/ПК-МПСЗ	Консультации с Членами, включая представителей частного сектора и научных кругов. Поддержка со стороны Секретариата (штаб-квартира)	Совещания, поддержка со стороны Секретариата	Апрель 2026 г.	План по интеграции нетрадиционных источников в КСОПВ	План разработан и представлен в ИНФОМ-3
1.5	Создание назначенных центров КСОПВ и поручение им задачи глобального реанализа климата	ИНФОМ-3	ИНФОМ/ПК-МПСЗ	Консультации с Членами, осуществляющими глобальный реанализ климата. Поддержка со стороны Секретариата (штаб-квартира)	Совещания, поддержка со стороны Секретариата	Апрель 2024 г.		На назначение претендуют ЕЦСПП и НАСА (США)
1.6	Предоставление большего объема продукции ЧПП как основных данных	ИНФОМ-3	ИНФОМ/ПК-МПСЗ, ММЦ и РСМЦ для ЧПП	Консультации с Членами. Поддержка со стороны Секретариата	Совещания, поддержка со стороны Секретариата	Март 2025 г.	Обновление перечней обязательной/рекомендуемой продукции РСМЦ для ЧПП в соответствии с потребностями Членов, зафиксированными на Симпозиуме ГСОДП (2022 г.)	Проекты обновленных перечней передаются на ИНФОМ-3
1.7	Предоставление индексов, связанных с воздействием и определенных в Наставлении по КСОПВ	ИНФОМ-4	ИНФОМ/ПК-МПСЗ, ММЦ и соответствующие РСМЦ	Консультации с СЕРКОМ и Членами. Поддержка со стороны Секретариата	Совещания, поддержка со стороны Секретариата	Март 2027 г.		

№	Задачи	Представить в (орган, например ИНФОМ-3)	Ответственный орган (группа, Секретариат и т. д.)	Консультации и поддержка (Секретариат и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Примерные сроки исполнения	Комментарии	Состояние
1.8	Четкое определение требований к графической продукции КСОПВ	ИНФОМ-4	ИНФОМ/ПК-МПСЗ	Консультации с СЕРКОМ и Членами. Поддержка со стороны Секретариата	Совещания, поддержка со стороны Секретариата	Март 2027 г.		Пилотный проект КСОПВ создан для визуализации продукции ММЦ
1.9	Изучение облачных технологий, ИПП и программного кода для доставки, обработки и использования данных	ИНФОМ-4	ИНФОМ/ИГ-БВД	Консультации с ПК-МПСЗ, ПК-УИИТ, СИ. Поддержка со стороны Секретариата	Совещания, поддержка со стороны Секретариата	Апрель 2024 г.		
1.10	Разработка процесса регулярного обзора потребностей КСОПВ	ИНФОМ-4	ИНФОМ/ПК-МПСЗ	Консультации с СЕРКОМ, СИ, РА. Поддержка со стороны Секретариата	Совещания, консультации, поддержка со стороны Секретариата	Апрель 2026 г.	Демонстрация РОП КСОПВ с СЕРКОМ	Концепция разработана и представлена на ИНФОМ-3
1.11	Сбор информации о потребностях в обучении, в том числе в области интерпретации больших ансамблей, неопределенностей и продукции прогнозирования	ГЭРП	РУЦ	Консультации с ППСР и РКЦ. Поддержка со стороны ИНФОМ/ПК-МПСЗ, Секретариата	Совещания, поддержка со стороны Секретариата	Декабрь 2024 г.	Сбор имеющихся учебных материалов в ММЦ	

Таблица 4. Проект плана работы по рассмотрению возникающих опасных явлений

Условные обозначения:

ИНФКОМ	Комиссия по наблюдениям, инфраструктуре и информационным системам	ПК-КЛИ	Постоянный комитет по климатическому обслуживанию
ГУ	Группа управления	ПВЛО	прорывы вод из ледниковых озер
СЕРКОМ	Комиссия по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды	ОСТП	программа «Окружающая среда третьего полюса»
КГ-ГСК	Консультативная группа по Глобальной службе криосферы	КСОПВ	Комплексная система обработки и прогнозирования ВМО
ПК-СРБ	Постоянный комитет по обслуживанию в области снижения риска бедствий и обслуживанию населения	РКЦ-сеть для третьего полюса	Региональная сеть климатических центров для третьего полюса
ЭГ-КОЯ	Экспертная группа ВМО по каталогизации опасных явлений, связанных с погодой, водой, климатом, окружающей средой и космической погодой	МАКН	Международная ассоциация криосферных наук
ПК-ГИД	Постоянный комитет по гидрологическому обслуживанию	ИПА	Международная ассоциация по изучению многолетней мерзлоты

№	Задачи	Представить в (орган, например ИНФОМ-3)	Ответственный орган (группа, Секретариат и т. д.)	Консультации и поддержка (Секретариат и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Примерные сроки исполнения	Комментарии	Состояние
1.1	Публикация обобщенной информации о категориях опасных явлений, связанных с криосферой, их характеристиках и пробелах/проблемах	ГУ ИНФОМ, ГУ СЕРКОМ,	КГ-ГСК	Секретариат (региональные бюро, Отдел мониторинга системы Земля), ПК-СРБ/ЭГ-КОЯ, ПК-ГИД, ПК-КЛИ под руководством КГ-ГСК	Консультации, практические семинары, Секретариат, публикация	Декабрь 2024 г.	Обзор литературы по существующим в настоящее время документально подтвержденным опасным явлениям	В I-II кв. 2024 г. создана консультативная практика
1.2	Развитие и публикация передового опыта в области прорывов вод из ледниковых озер (ПВЛО), включая практику инвентаризации ледниковых озер с картированием и оценкой рисков, а также потребности и пробелы в области их наблюдения, мониторинга и прогнозирования	ГУ ИНФОМ, ГУ СЕРКОМ,	КГ-ГСК	Сотрудничество с программой «Окружающая среда третьего полюса», Секретариат (инфраструктура, обслуживание)	Практические семинары, консультации, Секретариат, публикация	Июль 2025 г.	Отражение опыта ОСТП (Тибетское плато и Гиндукуш-Гималаи). Пробелы: мониторинг <i>in situ</i> и спутниковый мониторинг. Продукция КСОПВ	Планирование работы намечено на май 2024 г.

№	Задачи	Представить в (орган, например ИНФОМ-3)	Ответственный орган (группа, Секретариат и т. д.)	Консультации и поддержка (Секретариат и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Примерные сроки исполнения	Комментарии	Состояние
1.3	Отражение выявленных опасных явлений в Каталоге опасных явлений ВМО (КОЯ)	СЕРКОМ-4	СЕРКОМ/ПК-СРБ/ЭГ-КОЯ	КГ-ГСК, привлечение экспертных групп, например ОСТП, Международной ассоциации криосферных наук, Международной ассоциации по изучению многолетней мерзлоты, Секретариата (инфраструктура, обслуживание)	Практические семинары, консультации, консультативное взаимодействие	Октябрь 2025 г.	Это более долгосрочная задача, состоящая из нескольких этапов, первый из которых будет представлен на СЕРКОМ-4	К планированию работы предполагается приступить в сентябре 2024 г.
1.4	Пилотные рекомендации РКЦ-сети для третьего полюса	СЕРКОМ-4, ИНФОМ-4	РКЦ-сеть для третьего полюса	КГ-ГСК, привлечение экспертных групп, например ОСТП, Международной ассоциации криосферных наук, Международной ассоциации по изучению многолетней мерзлоты, Секретариата (инфраструктура, обслуживание)	Практические семинары, консультации, консультативное взаимодействие с экспертными группами (МАКН, ОСТП, ИПА)	2025–2027 г.	Планирование и реализация на основе результатов по пп. 1.1 и 1.2	К планированию работы предполагается приступить в феврале 2025 г.

№	Задачи	Представить в (орган, например ИНФОМ-3)	Ответственный орган (группа, Секретариат и т. д.)	Консультации и поддержка (Секретариат и т. д.)	Тип работы (совещания, практические семинары, консультации, Секретариат)	Примерные сроки исполнения	Комментарии	Состояние
1.5	Разработка каталога воздействий, справочника для оценки будущих рисков	СЕРКОМ-5	СЕРКОМ/ПК-СРБ	КГ-ГСК, привлечение экспертных групп, например ОСТП, Международной ассоциации криосферных наук, Международной ассоциации по изучению многолетней мерзлоты, Секретариата (инфраструктура, обслуживание)	Практические семинары, консультации, консультативное взаимодействие (МАКН, ОСТП, ИПА)	2026–2027 г. г.	Планирование и реализация на основе результатов по пп. 1.1, 1.2 и 1.4	К планированию работы предполагается приступить в феврале 2026 г.

Рекомендация 3 (ИНФОМ-3)

План осуществления Глобальной службы наблюдения за парниковыми газами

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на резолюцию 5 (Кг-19) «Глобальная служба наблюдения за парниковыми газами», в которой ИНФОМ, Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) и Совету по исследованиям (СИ) поручено, через совместную Исследовательскую группу, продолжить разработку концепции Глобальной службы наблюдения за парниковыми газами (ГСНПГ) посредством подробного плана осуществления, опираясь на существующие возможности и текущую деятельность в рамках Глобальной службы атмосферы (ГСА), включая Интегрированную глобальную информационную систему по парниковым газам (ИГИСПГ) и другие соответствующие международные структуры,

вновь подтверждая, что ВМО играет уникальную роль в выработке передовых практик в области методов измерений, данных и стандартов отчетности, валидации и взаимного сравнения информационной продукции, а также других передовых практик, необходимых для поддержки глобальной инфраструктуры мониторинга парниковых газов,

подчеркивая необходимость интеграции компонентов ГСНПГ в соответствующие координируемые ВМО системы, Интегрированную глобальную систему наблюдений ВМО (ИГСНВ), Информационную систему ВМО (ИСВ) и Комплексную систему обработки и прогнозирования ВМО (КСОПВ) и сотрудничества с соответствующими сообществами, поддерживающими координируемые ВМО системы,

принимая к сведению итоги практических семинаров по **моделированию** (Бонн, Германия, 19—21 сентября 2023 г.) и **измерениям** (Женева, Швейцария, 3—5 октября 2023 г.), организованных в поддержку разработки Плана осуществления ГСНПГ, и результаты опроса Членов о национальном потенциале для осуществления ГСНПГ,

рассмотрев проект плана осуществления ГСНПГ, разработанный совместной Исследовательской группой,

рекомендует Исполнительному совету принять План осуществления Глобальной службы наблюдения за парниковыми газами на основании проекта резолюции, представленного в дополнении к настоящей рекомендации.

Полный текст плана осуществления см. в INFCOM-3/INF. 7.2.

Дополнение к рекомендации 3 (ИНФОМ-3)

Проект резолюции №№/1 (ИС-78)

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на Стратегический план ВМО на 2024—2027 годы,

ссылаясь далее на резолюцию 5 (Кг-19) «Глобальная служба наблюдения за парниковыми газами», в которой Комиссии по наблюдениям, инфраструктуре и

информационным системам (ИНФКОМ), Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) и Совету по исследованиям (СИ) поручено, через совместную Исследовательскую группу, продолжить разработку концепции Глобальной службы наблюдения за парниковыми газами (ГСНПГ) посредством подробного плана осуществления, опираясь на существующие возможности и текущую деятельность в рамках Глобальной службы атмосферы (ГСА), включая Интегрированную глобальную информационную систему по парниковым газам (ИГИСПГ) и другие соответствующие международные структуры, и вернуть проект плана Исполнительному совету для рассмотрения и утверждения,

ссылаясь далее на принципы проектирования сети наблюдений, в частности принцип № 13 касательно развития устойчивости с точки зрения окружающей среды, в приложении 2.1 к [Наставлению по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160);

рассмотрев рекомендацию 3 (ИНФКОМ-3),

признавая роль ВМО как координатора деятельности, осуществляемой Членами, с учетом ее нейтральной позиции в отношении политики национальных правительств в области изменения климата, включая их усилия по оценке и сокращению выбросов ПГ,

признавая далее важные политические последствия данных мониторинга парниковых газов и, следовательно, рекомендуется проведение любого мониторинга парниковых газов в условиях полной прозрачности и в соответствии с [резолюцией 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земли» и содержащимся в ней призывом к свободному и неограниченному международному обмену данными о системе Земли,

признавая далее различия в возможностях наблюдения за парниковыми газами между Членами, план осуществления подчеркивает важность укрепления технологий, а также экспертных знаний и опыта на глобальном уровне,

признавая далее необходимость эффективного использования всеми Членами обслуживания ВМО для обеспечения качества наблюдений за парниковыми газами,

отмечая, что в завершение пятьдесят девятой сессии Вспомогательного органа для консультирования по научным и техническим аспектам (ВОКНТА 59), которая состоялась в ходе двадцать восьмой Конференции Сторон (КС 28, Дубай, 30 ноября — 13 декабря 2023 г.), ВОКНТА «отметил новую инициативу „Глобальная служба наблюдения за ПГ“, направленную на создание постоянного, регулярного глобального мониторинга концентраций и потоков парниковых газов. Он признал, что эта инициатива призвана улучшить количественную оценку как природных, так и антропогенных источников и поглотителей парниковых газов, а также дополнить кадастры выбросов, отметив, что следует применять руководящие принципы отчетности и кадастров парниковых газов, принятые в соответствии с Конвенцией и Парижским соглашением»,

с признательностью отмечая работу совместной Исследовательской группы по мониторингу парниковых газов ВМО (ИГ-ПГ) между ИНФКОМ, СЕРКОМ и СИ, проведенную для разработки плана осуществления,

с признательностью отмечая далее дополняющие усилия международных научных и пользовательских сообществ по разработке плана путем проведения практических семинаров по [моделированию](#) (Бонн, Германия, 19—21 сентября 2023 г.) и [измерениям](#) (Женева, Швейцария, 3—5 октября 2023 г.),

одобряет План осуществления Глобальной службы наблюдения за парниковыми газами, резюме которого приведено в дополнении I к настоящей резолюции;]

учитывая потребности в сохраняющихся обязательствах и вкладе в данный план осуществления всех ключевых заинтересованных сторон, участвующих в мониторинге парниковых газов, в особенности исследовательского сообщества, играющего важную роль в рамках Глобальной службы атмосферы (ГСА),

постановляет:

- 1) сформировать совместную консультативную группу под сопредседательством лиц, назначенных ИНФКОМ и СИ, для руководства осуществлением плана с соответствующим привлечением внешних заинтересованных сторон с кругом ведения, представленным в дополнении II к настоящей резолюции;
- 2) изучить полезность, круг ведения и состав членов Группы советников по климатической политике в связи с Действием GOV2 в плане осуществления;

настоятельно призывает Членов внести вклад в реализацию плана через рабочие группы ИНФКОМ, СИ и другие соответствующие органы ВМО, а также в консультации с их национальными координаторами Рамочной конвенции Организации Объединенных Наций об изменении климата (РКИК ООН) и Парижского соглашения;

порукает ИНФКОМ и СИ в координации с СЕРКОМ возглавить осуществление плана, следуя указаниям совместной Консультативной группы, и регулярно докладывать о ходе его выполнения Исполнительному совету и Консультативному комитету по вопросам политики;

предлагает президентам региональных ассоциаций активно поддерживать реализацию инициативы ГСНПГ;

признавая, что осуществление ГСНПГ зависит от результатов мобилизации ресурсов или от того, сможет ли Генеральный секретарь определить показатели эффективности,

порукает Генеральному секретарю:

- 1) обеспечить, в рамках существующих бюджетных ассигнований и административных механизмов, надлежащую сквозную деятельность в Секретариате для оказания поддержки в реализации плана;
- 2) продолжать укрепление сотрудничества и координации с соответствующими учреждениями Организации Объединенных Наций и другими международными партнерами, участвующими в деятельности по мониторингу и моделированию парниковых газов, и мобилизовать ресурсы партнеров для осуществления ГСНПГ, обеспечивая всем Членам равный доступ к ресурсам ВМО, включая средства обеспечения глобальной сопоставимости данных мониторинга ПГ;
- 3) взаимодействовать с заинтересованными сторонами на международных форумах, таких как Конференция Сторон РКИК ООН (КС), для популяризации развития и использования данных и продукции, производимых данной инфраструктурой;

призывает партнерские организации внести свой вклад в реализацию плана осуществления ГСНПГ.

Дополнение I к проекту резолюции №№/1 (ИС-78)

Глобальная служба наблюдения за парниковыми газами — ГСНПГ

План осуществления, резюме

Совместная Исследовательская группа по мониторингу парниковых газов

1. Введение и история вопроса

Всемирный метеорологический конгресс на своей девятнадцатой сессии (Кг-19, 22 мая — 2 июня 2023 г.) одобрил концептуальную записку и учредил новую инициативу по глобальному мониторингу парниковых газов, направленную на оказание поддержки Членам ВМО в осуществлении действий по смягчению последствий, предпринимаемых для реализации Парижского соглашения. Эта концепция была разработана ВМО в тесном сотрудничестве с партнерскими организациями, занимающимися вопросами парниковых газов и углеродного цикла.

Глобальная служба наблюдения за парниковыми газами (далее — ГСНПГ) восполняет пробелы в критически важной информации и обеспечивает интегрированную оперативную структуру, объединяющую все системы наблюдений, а также возможности моделирования и усвоения данных в отношении мониторинга парниковых газов, стремясь уменьшить неопределенность в оценке эффективности действий в области климата.

ГСНПГ обеспечит механизм всестороннего мониторинга ПГ и тем самым удовлетворит острую потребность в информации, которая помогает понять и оценить влияние действий по смягчению последствий, предпринимаемых Сторонами Рамочной конвенции Организации Объединенных Наций об изменении климата (РКИК ООН) и Парижского соглашения, на состояние климата. Такая информация будет готовиться своевременно и учитывать как антропогенное, так и природное влияние на уровень парниковых газов в атмосфере.

Основное внимание будет уделяться трем наиболее важным парниковым газам (далее — ПГ), на концентрацию которых влияет антропогенный фактор, а именно двуокиси углерода (CO₂), метану (CH₄) и закиси азота (N₂O). Согласно оценкам Межправительственной группы экспертов по изменению климата (доклад РГ1 ОД6 МГЭИК), увеличение концентраций этих газов в атмосфере служит основной причиной наблюдаемого изменения климата и возникновения связанных с ним последствий. Было зафиксировано, что недавнее (постиндустриальное) повышение концентраций CO₂, CH₄ и N₂O вызвано антропогенной деятельностью. В Парижском соглашении, принятом 196 Сторонами на Конференции Сторон РКИК ООН в 2015 году, установлены конкретные цели по максимальному повышению глобальной средней температуры и указано, что средством достижения этих целей является абсолютное сокращению выбросов ПГ.

В ходе двадцать восьмой Конференции Сторон (КС 28, Дубай, 30 ноября — 13 декабря 2023 г.) состоялась пятьдесят девятая сессия Вспомогательного органа для консультирования по научным и техническим аспектам (ВОКНТА 59). В своих выводах Вспомогательный орган для консультирования по научным и техническим аспектам (ВОКНТА) выразил признательность за достигнутый прогресс и по пункту «Исследования и систематическое наблюдение» (FCCC/SBSTA/2023/L.10) отметил:

«ВОКНТА отметил новую инициативу „Глобальная служба наблюдения за ПГ“, направленную на создание постоянного, регулярного глобального мониторинга концентраций и потоков парниковых газов. Он признал, что эта инициатива призвана улучшить количественную оценку как природных, так и антропогенных источников и поглотителей парниковых газов, а также дополнить кадастры выбросов, отметив, что следует применять руководящие принципы отчетности и кадастров парниковых газов, принятые в соответствии с Конвенцией и Парижским соглашением».

Упоминание КС 28 ГСНПГ в ВОКНТА существенно усиливает оперативную направленность действий по смягчению последствий изменения климата, начиная с двадцать седьмой Конференции Сторон (КС 27, Шарм-эш-Шейх, 6—20 ноября 2022 г.), когда Стороны признали, что «{...} ограничение глобального потепления до 1,5 °C требует быстрого, глубокого и устойчивого сокращения глобальных выбросов парниковых газов на 43 % к 2030 году по сравнению с уровнем 2019 года» (Decision -/CP.27). Далее она «подчеркивает {...} необходимость усиления координации деятельности сообщества систематических наблюдений и способности предоставлять полезную и имеющую практическую ценность климатическую информацию для смягчения последствий, адаптации и систем заблаговременных предупреждений, а также информацию, позволяющую понять пределы для адаптации и установить причины экстремальных явлений». Доступ к улучшенной согласованной информации о концентрациях и бюджетах ПГ, частично уже собранной существующими инфраструктурами, необходим для того, чтобы помочь странам установить свои обязательства и отслеживать прогресс в достижении целей по сокращению выбросов. Реагирование на призыв КС 27 требует усилий со стороны многочисленных учреждений и сообществ по совместной работе, созданию новых или обновлению существующих соглашений и договоренностей между международными и национальными учреждениями и различными органами ВМО.

Задачи и ожидаемые результаты ГСНПГ сформулированы в концептуальной записке, утвержденной и включенной в отчет девятнадцатого Всемирного метеорологического конгресса¹. В рамках первого [глобального подведения итогов](#)² (ГПД-1), представленного на КС 28, уже использовались некоторые системы, которые станут основополагающими для ГСНПГ, и был подчеркнут ограниченный прогресс в достижении целей Парижского соглашения, и данный результат подкрепляет необходимость ускорения темпов реализации широкомасштабных целей в их следующем раунде планов действий в области климата, который намечен на 2025 год.

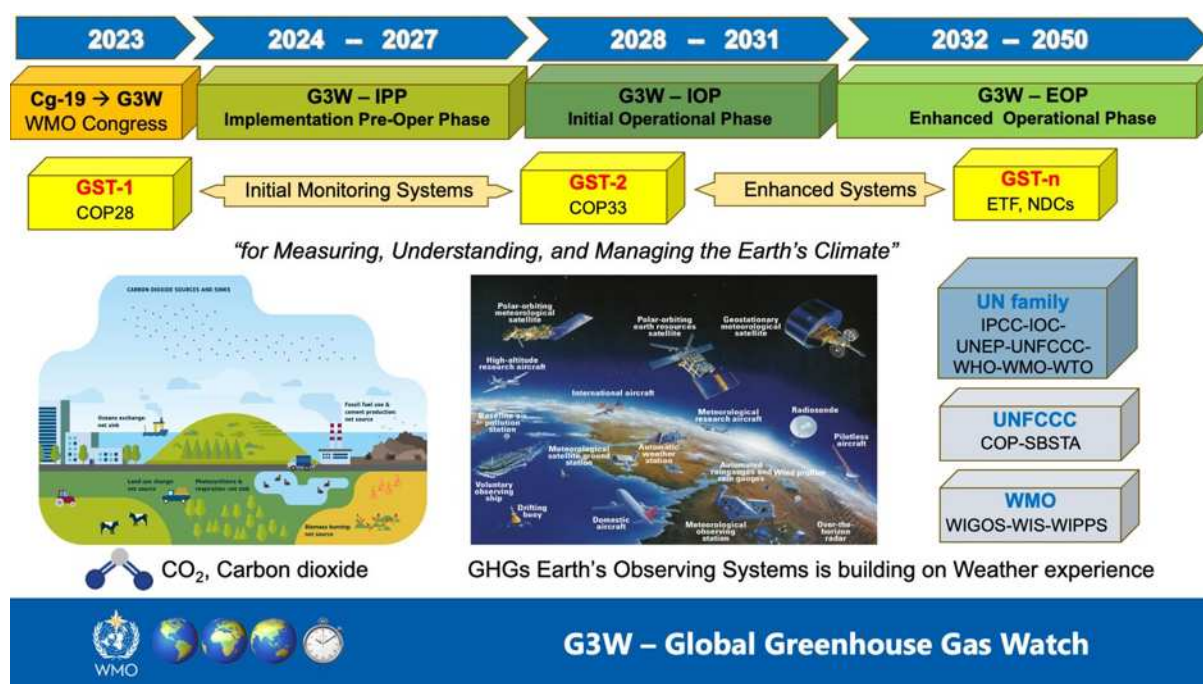


Рисунок 1. Инфографика с указанием сроков, масштаба и контекста осуществления ГСНПГ. Для упрощения представлен только CO₂, тогда как в Плане осуществления ГСНПГ основное внимание уделяется всем трем газам (CO₂, CH₄ и N₂O)

¹ <https://library.wmo.int/records/item/67177-world-meteorological-congress>

² https://unfccc.int/sites/default/files/resource/cma2023_L17_adv.pdf

Ожидается, что текущие и новые исследования, направленные на развитие возможностей для дальнейшего разделения этих чистых потоков на выбросы, распределенные по источникам, в будущем приведут к созданию дополнительной оперативной продукции. Согласно политике ВМО в области данных ([резолюция 1 \(Кг-Внеоч\(2021\)\)](#)) и в интересах обеспечения прозрачности, как того требует Парижское соглашение, ожидается, что данные будут доступны всем заинтересованным пользователям на безвозмездной и неограниченной основе.

План осуществления ГСНПГ (далее ПО-ГСНПГ) организован таким образом, чтобы Члены ВМО могли понять действия, требуемые в рамках текущего финансового периода (2024—2027 гг.), и содействовать их реализации для продвижения этапа осуществления и подготовки к эксплуатации ГСНПГ (ЭОП-ГСНПГ) (рисунок 1). В рамках следующего финансового периода (2028—2031 гг.) планируется начальный этап эксплуатации ГСНПГ (НЭЭ-ГСНПГ), включая консолидацию конфигурации систем ГСНПГ для второго [глобального подведения итогов](#) (ГПИ-2), о чем говорится в разделе «Концепция развития».

Видение ГСНПГ обеспечивается после 2032 года в полном соответствии с циклом Расширенных рамок для обеспечения транспарентности, предусмотренных Парижским соглашением (РРОТ-ПС), который обеспечит оценку прогресса в реализации крупномасштабной цели по достижению климатической нейтральности. ГСНПГ будет ориентирована на предоставление имеющей практическую ценность информации, помогающей странам в их долгосрочных стратегиях развития с низким уровнем выбросов парниковых газов (ДС-СРНВ), которые обеспечивают поддержку определяемых на национальном уровне вкладов (ОНУВ) в долгосрочной перспективе.

Этот этап развития ГСНПГ получил название «расширенный этап эксплуатации» (РЭЭ-ГСНПГ) и направлен на интеграцию развивающихся технологий спутникового дистанционного зондирования, наземных сетей, традиционных методов моделирования и методов моделирования на основе данных, появившихся благодаря искусственному интеллекту, с целью снижения неопределенности и повышения надежности систем мониторинга ПГ.

Для реализации плана необходимо создать рабочую структуру, которой будет поручено координировать деятельность по осуществлению, изложенную в различных разделах, чтобы обеспечивать ее своевременное выполнение и отчитываться перед Комиссией по инфраструктуре о прогрессе в достижении целей, сформулированных в плане. В эту рабочую структуру необходимо включить технических экспертов по инфраструктуре мониторинга ПГ.

Кроме того, необходимо создать группу, которая будет заниматься информационно-разъяснительной работой и мобилизацией ресурсов. Поскольку вовлечение исполнительного руководства ВМО имеет крайне важное значение, ГСНПГ должна напрямую отчитываться о текущей и планируемой деятельности перед Исполнительным советом ВМО.

Совместная Исследовательская группа по мониторингу парниковых газов (ИГ-ПГ) рекомендовала два действия, касающиеся управления:

Действие GOV1. Создать рабочую структуру при Комиссии по наблюдениям, инфраструктуре и информационным системам (ИНФКОМ) для координации деятельности по технической реализации. Сопредседателями Консультативной группы по ГСНПГ должны стать лица, назначенные ИНФКОМ и СИ, и предполагается, что в ее состав войдут до 20 членов, представляющих, в частности, Комиссию по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) и различные области экспертных знаний, относящихся к парниковым газам.

Действие GOV2. Проанализировать полезность Группы советников по климатической политике ВМО для позиционирования и информационно-разъяснительной работы на высоком уровне, скорректировав круг ведения и членский состав, чтобы всесторонне охватить темы ГСНПГ.

2. Основы ГСНПГ и пробелы

В концептуальной записке подробно изложены существующие компоненты ГСНПГ, которые составляют основу для осуществления (рисунок 2). Было проведено два технических семинара для дальнейшей оценки состояния текущих функциональных возможностей и уровня их готовности, а также для определения наиболее важных пробелов, которые необходимо устранить для продвижения осуществления ГСНПГ. В семинаре по наблюдениям приняли участие около 130 экспертов на местах и еще 70 — дистанционно, а семинар по моделированию был организован «по приглашению» и включал 30 экспертов, которые участвовали в очном режиме, и 20 экспертов, которые участвовали онлайн.

Основные итоги и рекомендации сформулированы в отчетах соответствующих совещаний, которые доступны в библиотеке ВМО.

G3W Infrastructure, Service, and R&D capabilities

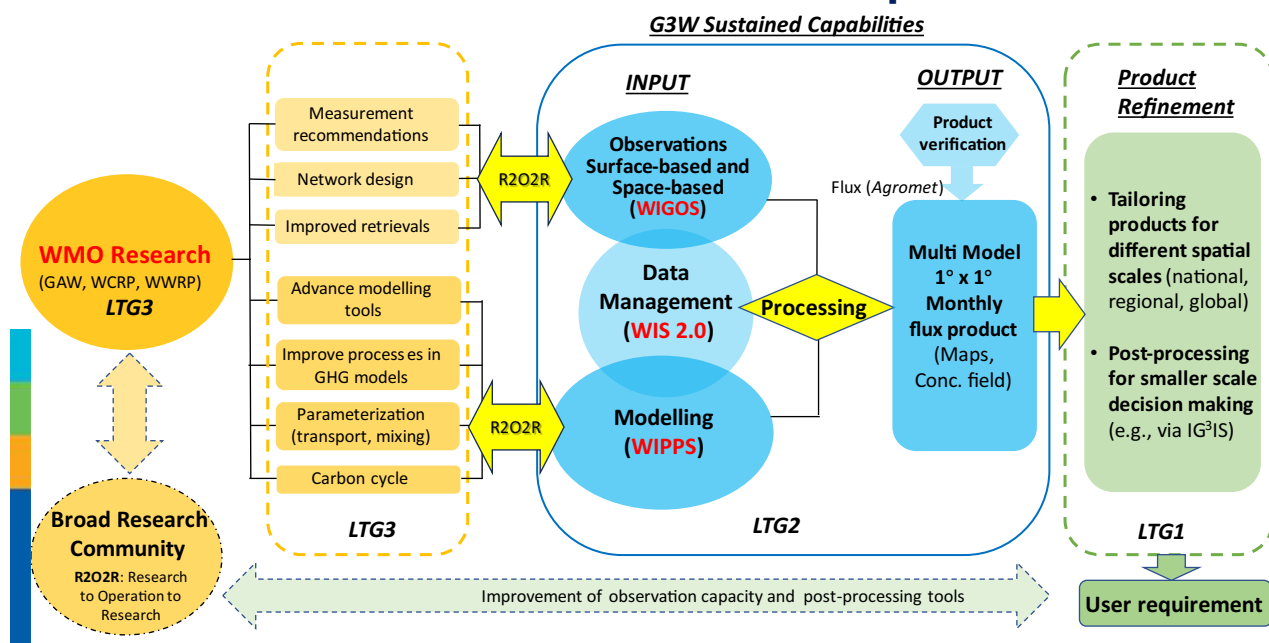


Рисунок 2. Схема осуществления ГСНПГ с указанием функциональных возможностей ГСНПГ и обеспечения соответствия обслуживания долгосрочным целям ВМО (ДЦ1, ДЦ2 и ДЦ3)¹

Исследовательская группа по мониторингу парниковых газов (ИГ-ПГ) — это совместная исследовательская группа, состоящая из 35 признанных экспертов из разных областей, приглашенных ВМО в августе 2022 года после того, как ИС-75 поручил совместной исследовательской группе разработать ПО-ГСНПГ. Подгруппы ИГ-ПГ осуществляют руководство разработкой различных структурных элементов, составляющих данный документ.

Структурные элементы ГСНПГ представлены в следующих шести разделах. Общепризнано, что наращивание потенциала, включая обучение, актуально для всех

¹ <https://library.wmo.int/records/item/68578-wmo-strategic-plan-2024-2027>

видов деятельности, перечисленных в технических разделах данного документа. Более того, хотя ГСНПГ нацелена на оперативное развертывание, признано, что компоненты исследований и обслуживания являются требованиями к уровню качества для непрерывного функционирования и необходимостью для всех структурных элементов.

3. Система наблюдений

Наблюдения составляют основу ГСНПГ, усвоения данных, моделирования и верификации. Они подробно описаны в концептуальной записке.

Следующие пункты действий были определены как приоритетные виды деятельности для продвижения осуществления ГСНПГ. Эти пункты действий организованы в несколько блоков, охватывающих пункты действий на стыке различных предметных областей и с использованием различных платформ (т. е. наземные платформы *in situ* и спутники), за которыми следуют пункты действий, относящиеся к конкретным областям. Подробная информация о видах деятельности, отчетном периоде и связях между пунктами действий приведена в полном тексте плана осуществления.

При создании сетей наблюдений, как *in situ*, так и наземных дистанционного зондирования, особое внимание следует уделять расширению сетей на НРС, МОСТРАГ и развивающиеся страны, особенно в регионах земного шара, где наблюдается дефицит данных.

3.1. Тема: Принципы проектирования сети наблюдений на стыке различных предметных областей

Действие О1. Создать исчерпывающий перечень существующих приземных измерений ПГ.

Показателями успеха являются:

- всеобъемлющий перечень измерений ПГ, который может быть использован в ГСНПГ, и интеграция недостающих элементов как в инструменте ОСКАР/Поверхность, так и в инструменте ОСКАР/Космос;
- анализ пробелов, в котором сравниваются переменные и охват, необходимые для моделей инверсии (действия Р1—Р3), с измеряемыми в настоящее время переменными и их охватом.

Действие О2. Разработать стандарты мониторинга ПГ, пересмотреть и согласовать существующие требования к измерению ПГ.

Показателями успеха являются включение установленных требований к наблюдениям в базу данных Инструмента анализа и обзора возможностей систем наблюдений/Потребности (ОСКАР/Потребности), библиотека руководящих указаний по обеспечению качества / контролю качества (ОК/КК) и спецификации многоуровневой сети.

Действие О3. Разработать дорожную карту для осуществления деятельности в области долгосрочных наблюдений за ПГ.

Показателем успеха будет долгосрочная стратегия обеспечения устойчивой системы наблюдений, направленная на ее устойчивое финансирование.

3.2 Тема: Наземные измерения *in situ* ПГ в приземном слое (атмосфера)

Действие О4. Устранить существующие пробелы в пространственно-временных данных наземных наблюдений за ПГ в приземном слое (атмосфера).

Показателями успеха являются эффективная и адекватная структура сети учитывающая доступ к региональным/центральному калибровочным установкам в регионах с дефицитом данных обновленные технические правила и список возможностей для развертывания. Это будет итеративный процесс, в котором учитываются меняющиеся потребности на основе результатов, полученных от существующей сети.

Действие 05. Разработать устойчивую высококачественную опорную сеть измерений ПГ (уровень 1) (атмосфера).

Показателями успеха являются:

- определение и технические правила, касающиеся сети уровня 1, включенные в Технический регламент ВМО;
- разработанные руководящие указания по измерениям / стандартные эксплуатационные процедуры для сети высшего уровня.

Действие 06. Разработать базовую («соответствующую целевому назначению») сеть измерений ПГ (уровень 2) (атмосфера).

На ранней стадии реализации рекомендуется разработать спецификацию для экономически эффективной системы (систем) мониторинга воздуха, отвечающей(их) требуемым характеристикам для обнаружения соответствующих парниковых газов. Это позволит учесть требования к эксплуатации, техническому обслуживанию, логистике и бюджету для стандартной системы мониторинга, не требующей поддержки (т. е. требующей ограниченного вмешательства со стороны человека), которая должна быть включена в существующие сети и инфраструктуру метеорологического и атмосферного мониторинга.

Показателями успеха являются:

- руководящая документация по «соответствующей целевому назначению» системе наблюдений;
- стратегия взаимодействия с «сообществом специалистов-практиков»;
- учебные материалы для «сообщества специалистов-практиков».

3.3 Тема: Вертикально разрешенные наблюдения за ПГ, *in situ* и дистанционное зондирование (атмосфера)

Действие 07. Расширить число пунктов наблюдений, осуществляющих дистанционное зондирование и вертикально разрешенные наблюдения за ПГ.

Показателем успеха является уровень достижения ежегодных целей по наблюдениям за профилями в пунктах наблюдений в соответствии с установленными сроками, включая указание методов развертывания.

3.4. Тема: Наблюдения в поверхностном слое океана

Действие 08. Придать официальный статус устойчивой сети наблюдений за CO₂ в поверхностном слое океана и укреплять ее.

Показателями успеха являются:

- создание руководящего органа для Сети наблюдений за CO₂ в поверхностном слое океана (СОКОНЕТ);

- дорожная карта для устойчивого финансирования наблюдений за CO₂ в поверхностном слое океана;
- план работы по устранению пробелов в наблюдениях в регионах с недостаточными данными;
- расширение охвата наблюдениями в регионах с недостаточными данными;
- инициализация и оценка ценности наблюдений за CH₄ и N₂O в критически важных пунктах наблюдений и регионах (например, в зонах высокой концентрации и потока, таких как материковые окраины, зоны уязвимости и воздействия клатрата метана (замороженного метана) и высокие широты).

Действие O9. Предоставлять регулярную глобальную продукцию потоков CO₂ между атмосферой и океаном в узлах регулярной сетки.

Показателями успеха являются:

- создание структуры управления для Атласа концентраций CO₂ в поверхностном слое океана (СОКАТ) — на базе инфраструктуры ГСНО в рамках Группы экспертов ГСНО по биогеохимии / МКПОУ;
- устойчивое финансирование управления данными по ПГ в поверхностном слое океана и соответствующей продукции;
- определенный пространственный охват и частота наблюдений за CO₂ в поверхностном слое океана;
- продемонстрированный четкий путь для своевременного, интегрированного, бесперебойного и функционально совместимого потока данных в ГСНПГ.

3.5 Тема: Космические наблюдения за ПГ и соответствующими переменными

Действие O10. Взаимодействовать и определять приоритетные задачи с Комитетом по спутниковым наблюдениям за Землей (КЕОС) и Координационной группой по метеорологическим спутникам (КГМС) для проведения прямых наблюдений за ПГ из космоса.

Предлагаются следующие показатели успеха:

- совместная с КЕОС экспертная группа по вопросам деятельности в области ПГ;
- приоритетный список космических наблюдений за ПГ, требующих непрерывности;
- приоритетный список космических наблюдений за совместно выбрасываемыми соединениями, требующих непрерывности;
- приоритетный список новых космических наблюдений за ПГ, восполняющих пробелы в наблюдениях;
- всеобъемлющий, документированный и последовательный набор требований к данным для поддержки модельных инверсий Системы мониторинга и верификации над сушей, океаном и льдом.

Действие O11. Взаимодействовать и определять приоритетные задачи с КЕОС и КГМС для проведения косвенных наблюдений за ПГ из космоса (необходимо для определения потоков ПГ).

Предлагаются следующие показатели успеха:

- совместная экспертная группа с Группой экспертов по наблюдениям за поверхностью суши в интересах изучения климата (ГЭНПСК) / ГСНК и инициативой КЕОС по сельскому хозяйству, лесному хозяйству и другим видам землепользования (СХЛХДВЗ);
- приоритетный список космических наблюдений, требующих непрерывности, касающихся накоплений, изменений и потоков углерода, связанных с СХЛХДВЗ;
- приоритетный список новых космических наблюдений, восполняющих пробелы, касающихся накоплений, изменений и потоков углерода, связанных с СХЛХДВЗ;
- список необходимых космических наблюдений за важнейшими климатическими переменными (ВКлП), поддерживающих научную основу мониторинга ПГ;
- всеобъемлющий, документированный и последовательный набор требований к данным для поддержки модельных инверсий Системы мониторинга и верификации.

Действие O12. Взаимодействовать и определять приоритетные задачи с КЕОС и КГМС в отношении необходимых космических наблюдений для мониторинга изменений в углеродном цикле в условиях (будущего) меняющегося климата.

Предлагаются следующие показатели успеха:

- приоритетный список (будущих) космических наблюдений, требующих непрерывности;
- приоритетный список (будущих) новых космических наблюдений, восполняющих пробелы;
- отчет с описанием ожидаемых изменений в углеродном цикле и способов наблюдения за ними из космоса.

4. Система моделирования

Глобальные системы моделирования и усвоения данных станут еще одним основополагающим элементом ГСНПГ и описаны в концептуальной записке. Участвующие центры получают выгоду от координации ГСНПГ, а усилия по разработке руководящих указаний и передовых практик будут продолжены, как описано в действиях ниже.

Действие M1. Установление требований к оперативным центрам и информационной продукции.

Основными показателями успеха данного вида деятельности являются созданная нормативная база в рамках Комплексной системы обработки и прогнозирования ВМО (КСОПВ) для оперативных центров, а также документация по требуемой продукции и результатам участвующих систем моделирования.

Действие M2. Документация оперативных центров.

Показателями успеха являются документация, подготовленная центрами моделирования, принявшими установленные стандарты, и документация по протоколам сравнения.

Действие M3. Непрерывная разработка и эксплуатация (включая регулярный обзор потребностей).

Показателями успеха являются документация и обмен документами по планированию, а также развитие возможностей для получения отзывов от пользователей (например, пользовательские форумы, служба поддержки веб-сайта).

Действие М4. Получение и предварительная обработка данных наблюдений.

Показателем успеха является обмен между центрами эффективными практиками и протоколами для сбора и предварительной обработки данных.

Действие М5. Осуществление / предварительная обработка данных о предварительных выбросах.

Показателями успеха являются обмен промежуточной информационной продукцией и программным обеспечением для предварительной обработки, а также эффективными практиками по подготовке априорных предположений.

Действие М6. Общие подходы в функционировании оперативных центров.

Показателем успеха являются совместные оперативные планы оперативных центров.

Действие М7. Оценка и контроль качества продукции моделирования.

Показателями успеха являются внедрение эффективных практик в оперативных центрах и установление «хороших показателей» работы моделей.

5. Предварительная информация

Основой ГСНПГ является включение в модели данных наблюдений для оценки и уменьшения неопределенности в потоках ПГ. Этот анализ в решающей степени зависит от качества вспомогательных данных, предварительной информации о потоках и оценок их неопределенности.

Глобальные центры моделирования/подготовки, которые будут участвовать в ГСНПГ, должны по возможности использовать независимые друг от друга методы генерирования и использования предварительной информации для своих систем усвоения данных, чтобы обеспечить независимость продукции.

Действие Р1. Определить потребности в потоке данных о предварительных выбросах и поглощении CO₂.

Показателями успеха являются список требований, который предоставляется оперативными центрами / оперативным центрам, и полная документация по переменным.

Действие Р2. Определить потребности в потоке данных о предварительных выбросах и поглощении CH₄.

Показателями успеха являются список требований, который предоставляется оперативными центрами / оперативным центрам, и полная документация по переменным.

Действие Р3. Определить потребности в потоке данных о предварительных выбросах и поглощении N₂O.

Показателями успеха являются список требований, который предоставляется оперативными центрами / оперативным центрам, и полная документация по переменным.

Действие Р4. Охарактеризовать различные потоки, принимаемые хранилищем, в различных временных масштабах.

Показателем успеха является обобщенная информация о том, что известно о дисперсии ошибок, и о том, что неизвестно, которая выкладывается в открытый доступ.

6. Управление данными

Управление данными играет важную роль в осуществлении ГСНПГ. Соответствующее управление данными следует организовать в первоочередном порядке.

Приведенные ниже пункты действий основываются на четырех этапах управления данными — от прибора до усвоения данных, обеспечения качества моделей и предоставления данных сообществу пользователей.

Действие D1. Этап 1 жизненного цикла управления данными: от необработанных данных прибора до охарактеризованного продукта, приемлемого для международного обмена данными.

Показателями успеха являются:

- периодическая проверка национальных центров (инфраструктура, оборудование и стандарты) региональным центром;
- периодическая проверка и продление аккредитации региональных центров ответственными конституционными органами ВМО, а именно Постоянным комитетом по управлению информацией и информационным технологиям (ПК-УИИТ) и Постоянным комитетом по вопросам измерений, приборного оснащения и прослеживаемости (ПК-ИПП);
- процент данных, отправленных с каждой станции, качество этих данных и их вклад в конечную продукцию;
- публикация эффективных практик по подготовке необработанных данных для международного обмена данными;
- расширение возможностей существующих глобальных центров данных о ПГ и/или создание новых центров, необходимых для выполнения функций по управлению данными (включая долгосрочное архивирование данных).

Действие D2. Этап 2 жизненного цикла управления данными: передача данных наблюдений от поставщиков в оперативные центры для усвоения.

Показателями успеха являются детальная проработка архитектуры данных, эффективность системы передачи данных и ее скорость, а также способность предоставлять необходимые данные всем центрам с одинаковой эффективностью.

Действие D3. Этап 3 жизненного цикла управления данными: предоставление выходных данных моделей оперативных центров для взаимных сравнений.

Показателем успеха является сокращение трудозатрат и стоимости/времени вычислений для проведения взаимных сравнений моделей.

Действие D4. Этап 4 жизненного цикла управления данными: обнаружение данных моделирования и их распространение среди конечных пользователей.

Показателями успеха являются:

- количество пользователей, использующих информационную продукцию;
- количество рецензируемых публикаций, использующих наборы данных ГСНПГ;

- представление наборов данных ГСНПГ в средствах массовой информации;
- количество информационной продукции, появляющейся во внешних каталогах, таких как Обмен информацией (ОИ), Международный обмен океанографическими данными и информацией (МООД) и Система океанических данных и информации (СОДИ).

Действие D5. Хранилище данных о предварительных выбросах и поглощении.

Показателями успеха являются:

- оценка размера данных;
- сокращение расходов на передачу данных и доступ к данным;
- полученные обязательства со стороны выбранной инфраструктуры.

Действие D6. Определение поставщиков предварительных данных.

Показателем успеха является список критериев для поставщиков предварительных данных и набор инструментов и правил их оценки.

Действие D7. Определение политики в области данных для хранилища данных о предварительных потоках.

Показателем успеха является общедоступность политики в области данных.

7. Потребности ГСНПГ в исследованиях и разработках

Для постоянной поддержки и совершенствования операционной инфраструктуры необходима ярко выраженная исследовательская составляющая. В приведенных ниже пунктах действий изложены основные направления взаимодействия между ГСНПГ и исследованиями.

Действие R1. Создать целевую группу ГСНПГ по переходу от исследований к оперативной деятельности (ИКОД) в рамках Совета по исследованиям.

Показателями успеха являются созданная целевая группа и презентация стратегии для СИ.

Действие R2. Повышать возможности в области наблюдений и обмена данными.

Показателями успеха являются:

- публикация заявления о руководящих принципах;
- отчет/публикация по методам и средствам измерений;
- инструменты для автоматизированного ОК/КК.

Действие R3. Повышать возможности в области моделирования ПГ и инверсии потоков.

Показателями успеха являются результаты исследований, которые могут быть внедрены в оперативные системы.

8. Привлечение пользователей и использование результатов работы ГСНПГ

Необходима согласованная информация об источниках и поглотителях парниковых газов в различных масштабах. Приведенные ниже пункты действий определяют дальнейший путь к использованию результатов работы ГСНПГ.

Действие U1. Оказывать поддержку глобальному подведению итогов (ГПИ).

Показателями успеха являются:

- официальное признание ГСНПГ в процессе ГПИ;
- количество презентаций ГСНПГ в рамках технических диалогов и дней информации о Земле;
- использование результатов работы ГСНПГ посредством публикаций в оценках МГЭИК;
- использование результатов работы ГСНПГ в качестве независимой ссылки при представлении кадастра для КС.

Действие U2. Разработать руководящие положения по региональной продукции.

Показателями успеха являются:

- количество Сторон, использующих результаты работы ГСНПГ для ГПИ;
- цитирование по официальным отчетам/оценкам;
- сопоставимость с кадастрами МГЭИК или другими оценками.

Действие U3. Установить отношения между ГСНПГ и Интегрированной глобальной информационной системой по парниковым газам (ИГИСПГ), СЕРКОМ. Определить пути взаимодействия с заинтересованными сторонами.

Показателями успеха являются:

- совместный показательный проект между указанными органами;
- совместный практический семинар и заседания;
- сформулированный порядок отношений между ГСНПГ и ИГИСПГ в круге ведения Консультативной группы по ГСНПГ.

Действие U4. Разработать руководящие указания по взаимодействию с пользователями.

Показателями успеха являются:

- требования к информационному обслуживанию ГСНПГ определены и передаются обратно оперативной системе;
- разработанные руководящие указания по использованию данных и продукции ГСНПГ;
- документированные примеры того, как информационная продукция ГСНПГ позволяет проводить кадастровую оценку.

9. Нарращивание потенциала

Внедрение ГСНПГ должно сопровождаться всеобъемлющим наращиванием потенциала и осуществлением программы по подготовке кадров. Ниже перечислены действия, в рамках которых будут осуществляться мероприятия, направленные на достижение необходимого уровня потенциала Членов для осуществления ГСНПГ:

C1. Создать систему компетенций для участия в ГСНПГ.

C2. Постоянная оценка потенциала в области ПГ, способствующего работе ГСНПГ

C3. Развивать потенциал Членов в области использования данных ГСНПГ.

C4. Разработать программы обучения по ПГ для Членов.

C5. Разработать программы двусторонних отношений и обмена между странами для развития национального потенциала в области наблюдений, моделирования, управления данными и использования данных по ПГ.

10. Финансовые оценки и источники финансирования

Оценки затрат представлены в следующих разделах: i) затраты на координацию ГСНПГ, которые могут быть точно оценены на основе прогнозируемых эквивалентов полной занятости (ЭПЗ), и расходы на логистику, которые сгруппированы под названием «Рабочая сила» и включают в себя как развитие потенциала, так и координацию; ii) затраты на производство наблюдений, моделирование и управление данными, сгруппированные под названием «Инфраструктура», где оценки основаны на секторальных исследованиях авторитетных источников.

Общепризнано, что глобальная эффективность ГСНПГ будет обеспечиваться за счет взаимодополняемости усилий, поддерживаемых централизованными и региональными инвестициями, при использовании источников финансирования, которые подробно описаны в разделе 11, и без непосредственного участия НМГС, если они не выступают в качестве добровольных доноров.

Целевым для мобилизации ресурсов ГСНПГ является сценарий финансирования флагманского уровня в размере 1 млрд долл. США в течение финансового периода 2024–2027 годов, в то время как в полном тексте плана осуществления приведены сценарии финансирования более низкого уровня, чтобы показать распределение ресурсов в случае частичного достижения. Ожидается, что эти ресурсы будут поступать из финансового сектора, включая Всемирный банк, центральные банки, многосторонние банки развития, страховые компании и перестраховочные компании, благотворительные фонды, гранты на финансирование климатических проектов, фонды для покрытия потерь и ущерба, а также из промышленного сектора через природоохранные, социальные и управленческие (ПСУ) методы наряду с более традиционными финансовыми мерами, обусловленными социально ответственным инвестированием.

Планом расходов ГСНПГ флагманского уровня в качестве главного приоритета определены приземные наблюдения, таким образом, предполагается, что 70 % будет инвестировано в инфраструктуру системы приземных наблюдений, 20 % — в интеграцию систем наблюдений, моделирование и управление данными, 5 % — в создание потенциала и развитие возможностей для предоставления информации для ГСНПГ и использования результатов ее работы, 4 % — в региональные экспериментальные проекты и поддержку исследований по возникающим приоритетам ГСНПГ, и 1 % — в центральную координацию Секретариата ВМО, в том числе в развитие государственно-частных партнерств (ГЧП). Ожидается, что экономические выгоды ГСНПГ от использования сети приземных наблюдений в 25 раз превысят стоимость инвестиций, а по сравнению с ожидаемыми затратами на оперативные приземные и космические наблюдения за погодой в 10 млрд долл. США в год это составляет увеличение ежегодных затрат менее чем на 2,5 %¹.

¹ The Value of Surface-based Meteorological Observation Data, D. Kull et al., 2021, World Bank, <https://doi.org/10.1596/35178>.

11. Мобилизация ресурсов

Мобилизация ресурсов для ГСНПГ является частью более широкой деятельности ВМО по привлечению добровольных взносов для достижения ее стратегических задач, в том числе в поддержку смягчения последствий изменения климата. Стратегия ВМО по мобилизации ресурсов согласуется с ЭОП-ГСНПГ в 2024–2027 годах, координируемым ВМО, в соответствии с резолюцией Всемирного метеорологического конгресса. В связи с этим у ГСНПГ нет отдельной стратегии по мобилизации ресурсов. ГСНПГ наряду с инициативой «Заблаговременные предупреждения для всех» (ЗПДВ) и Глобальной опорной сетью наблюдений (ГОСН) входят в число приоритетных инициатив ВМО, включающих целый комплекс мероприятий по поддержке и оценке действий в области климата, имеющих в распоряжении РКИК ООН. Как и в случае с другими инициативами, в число ее спонсоров могут входить традиционные и новые доноры, климатические фонды, включая Фонд финансирования систематических наблюдений (ФФСН), многосторонние банки развития (МБР), благотворительные фонды и частный сектор, признающие, что смягчение последствий изменения климата — это не только необходимость для обеспечения устойчивого развития, но и корпоративный долг во многих странах (например, политика в области ПСУ вопросов). Действия по мобилизации ресурсов ГСНПГ будут направлены на покрытие текущих расходов на инфраструктуру и обслуживание ГСНПГ и, следовательно, будут охватывать всю ВМО.

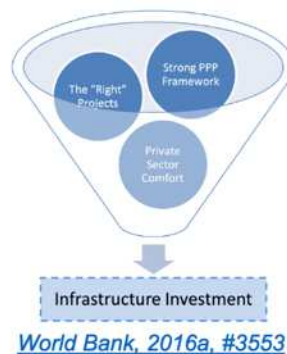
В частности, ресурсы будут направлены на удовлетворение потребностей в руководстве техническими аспектами, координацией, мониторингом и коммуникациями ГСНПГ, а также на не относящийся к ВМО вклад в ГСНПГ, чтобы помочь гарантировать, что поддержка действий в области климата и развития и инвестиции прочно основаны на науке и обслуживании для общества в соответствии с потребностями Членов ВМО.

G3W Financial Sustainability

To address infrastructure / service needs G3W aims at **significant resources increase in 2024-2027**.

Funding mechanisms include 3 pathways:

- **G3W initial WMO-funds**, approved by the CG-19 resolutions of World Meteorological Congress in 2023.
- **G3W trust-fund**, managed by WMO, with two Champions Nations contributing in 2023 and more expected from Public & Private sources from 2024.
- **Specialized G3W financial vehicle** to facilitate wider private sector contributions and activities, such as impact investing, that can be hosted outside of the UN system.



G3W – Global Greenhouse Gas Watch

Рисунок 3. Механизмы финансирования ГСНПГ для обеспечения финансовой устойчивости

12. Концепция развития

Концепция развития ГСНПГ охватывает ЭОП-ГСНПГ в финансовый период 2024–2027 годов. Первые два года будут посвящены наращиванию необходимых людских и финансовых ресурсов как в Секретариате ВМО, так и в оперативных центрах, чтобы вся цепочка была взаимосвязана и приведена в движение, а основные средства наблюдений стали доступны в соответствии с согласованными стандартами.

Предполагается, что ЭОП-ГСНПГ будет включать существенный прогресс и корректировку для достижения и/или повышения эффективности.

НЭЭ-ГСНПГ начнется в следующем финансовом периоде (2028—2031 гг.) и будет включать консолидацию конфигурации систем ГСНПГ для второго ГПИ, который является ключевым моментом в цикле РРОТ-ПС, поскольку он позволит оценить прогресс в отношении первого ГПИ.

НЭЭ-ГСНПГ будет служить Нациям в разработке новых ОНУВ и установлении неопределенностей в оценке темпов роста/снижения концентраций ПГ. В рамках НЭЭ-ГСНПГ в 2030 году будет проведена обширная оценка положения дел в области смягчения последствий изменения климата для определения требований и широкомасштабных целей в рамках РЭЭ-ГСНПГ в полном соответствии с требованиями РРОТ-ПС.

РЭЭ-ГСНПГ будет направлен на предоставление имеющей практическую ценность информации, помогающей Нациям, Сторонам РКИК ООН в их ДС-СРНВ, обеспечивая также поддержку ОНУВ в долгосрочной перспективе, в которых обозначены крупномасштабные цели по разрешению климатического кризиса и одновременно кризиса неравенства, чтобы никто не остался в стороне.

Существует множество видов деятельности, которые необходимо реализовать после первых четырех лет. Они связаны с расширением возможностей наблюдений и моделирования. Многие из этих действий охватывают океаническую и наземную области, поскольку первоначально ГСНПГ сосредоточена на измерении чистых потоков.

Подробная концепция развития конкретных компонентов ГСНПГ приведена в полном тексте Плана осуществления.

Дополнение II к проекту резолюции xx/1 (ИС-78)

Консультативная группа по Глобальной службе наблюдения за парниковыми газами (КГ-ГСНПГ)

Круг ведения

Цель

Под руководством Исполнительного совета Консультативная группа по Глобальной службе наблюдения за парниковыми газами (КГ-ГСНПГ) будет осуществлять надзор, координацию и мониторинг в отношении Плана осуществления Глобальной службы наблюдения за парниковыми газами (ПО-ГСНПГ), который должен быть утвержден Исполнительным советом в июне 2024 года.

В частности, КГ-ГСНПГ будет сосредоточена на интеграции элементов инфраструктуры ГСНПГ в Интегрированную глобальную систему наблюдений ВМО (ИГСНВ), Информационную систему ВМО (ИСВ) и Комплексную систему обработки и прогнозирования ВМО (КСОПВ) с целью более качественного представления парниковых газов в системах моделирования.

КГ-КСОПВ будет функционировать в рамках общего круга ведения консультативных групп и будет:

- а) выступать в качестве отправной точки по вопросам, связанным с оперативными наблюдениями, управлением данными и моделированием парниковых газов;

- b) консультировать Группу управления по вопросам потребностей в исследованиях и обслуживании, связанных с оперативными наблюдениями за парниковыми газами, управлением данными и моделированием;
- c) осуществлять надзор, координацию и мониторинг в отношении ПО-ГСНПГ;
- d) консультировать Группу управления и постоянные комитеты по вопросам оптимальной рабочей структуры и привлечения экспертов в данной области для достижения конкретных ожидаемых результатов, предусмотренных ПО, содействуя интеграции функций системы наблюдений, обмена данными, управления данными и прогнозирования в ИГСНВ, ИСВ и КСОПВ и обеспечивая при этом необходимую координацию работы экспертов в данной области;
- e) при поддержке Секретариата ВМО консультировать Группу управления, постоянные комитеты и другие органы по мере необходимости по вопросам согласования ожидаемых результатов ГСНПГ с задачами Стратегического плана ВМО;
- f) проводить работу с Группой экспертов Исполнительного совета по развитию потенциала через Координатора по развитию потенциала по вопросам развития потенциала, включая подготовку кадров;
- g) консультировать Группу управления и оказывать помощь вице-президенту, представляющему данную область, по вопросам взаимодействия с соответствующими организациями системы Организации Объединенных Наций, Межправительственной группой экспертов по изменению климата, Рамочной конвенцией Организации Объединенных Наций об изменении климата, Межправительственной океанографической комиссией и другими организациями для дальнейшего привлечения вклада и установления партнерских отношений с целью реализации ПО-ГСНПГ;
- h) устанавливать рабочие отношения с Руководящим комитетом по ИГИСПГ и Постоянным комитетом по климатическому обслуживанию Комиссии по обслуживанию для выполнения задач, связанных с привлечением пользователей и политическим взаимодействием;
- i) предоставлять советникам ВМО по вопросам климатической политики материалы по техническим вопросам.

Членский состав

Сопредседателями КГ-ГСНПГ станут лица, назначенные ИНФКОМ и СИ, а в состав войдут до 20 экспертов, представляющих все Регионы ВМО и обладающих необходимыми экспертными знаниями и опытом в области парниковых газов на стыке различных областей и функций. Предлагается, чтобы КГ-ГСНПГ рассмотрела возможность привлечения экспертов от Членов ВМО, особенно тех, кто обладает экспертными знаниями и опытом в области оперативной деятельности по наземным и/или космическим наблюдениям за ПГ и моделирования ПГ.

Порядок работы

Большая часть работы будет осуществляться по электронной почте и посредством теле-/видеоконференций с возможностью проведения совещаний в очной форме, если сопредседатели сочтут это целесообразным и при условии наличия ресурсов.

Ожидаемые результаты

Ожидаемые результаты, приведенные в соответствии с программой работы Комиссии.

Рекомендация 4 (ИНФОМ-2)

Поправки к Наставлению по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1160)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля»,
- 2) [резолюцию 1 \(ИНФОМ-2\)](#) «Программа работы Комиссии»,
- 3) [резолюцию 18 \(ИС-76\)](#) «Поправки к *Наставлению по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1160)»,
- 4) [резолюцию 41 \(ИС-76\)](#) «Процедуры для внесения поправок в *Технический регламент* (ВМО-№ 49), дополнения к нему, руководства и другие соответствующие нерегламентные публикации»,
- 5) [резолюцию 2 \(Кг-19\)](#) «Стратегический план ВМО на 2024—2027 годы»,
- 6) [резолюцию 20 \(Кг-19\)](#) «Руководящие указания высокого уровня по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году»,
- 7) [резолюцию 21 \(Кг-19\)](#) «Осуществление Глобальной опорной сети наблюдений»,
- 8) [резолюцию 47 \(Кг-19\)](#) «Обязательные публикации ВМО и политика в области распространения на девятнадцатый финансовый период»,

отмечая также [резолюцию 4 \(ИНФОМ-3\)](#) «*Руководство по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1165)»,

отмечая, что проект поправок рассмотрен Постоянным комитетом по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ),

отмечая далее итоги семинара ВМО по базовым спутниковым данным (5—7 декабря 2023 года), а также то, что политика спутниковых операторов в отношении данных может отличаться и регулярно обсуждается в рамках Координационной группы по метеорологическим спутникам (КГМС),

изучив проект поправок к *Наставлению по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1160) в дополнении к настоящей рекомендации, и в особенности:

- 1) включение наблюдательного компонента для космической погоды;
- 2) включение вопросов, касающихся радиочастот (РЧ);
- 3) обновление принципов мониторинга климата в рамках Глобальной системы наблюдений за климатом;
- 4) разъяснение требований Глобальной опорной сети наблюдений (ГОСН);

- 5) корректировку структуры Региональной опорной сети наблюдений (РОСН);
- 6) включение основных и рекомендуемых спутниковых данных;
- 7) корректировку базового плана КГМС;
- 8) включение практики передачи сводок DAYCLI,

рекомендует Исполнительному совету принять поправки к [Наставлению по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160) посредством проекта резолюции, представленного в дополнении к настоящей рекомендации.

Дополнение к рекомендации 4 (ИНФКОМ-3)

Проект резолюции №№/1 (ИС-78)

Поправки к Наставлению по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1160)

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на:

- 1) статью 2, пункты «а» и «с», и статью 8, пункт «d», Конвенции Всемирной метеорологической организации,
- 2) [резолюцию 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля»,
- 3) [резолюцию 2 \(ИНФКОМ-3\)](#) «Программа работы Комиссии»,
- 4) [резолюцию 18 \(ИС-76\)](#) «Поправки к Наставлению по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1160)»,
- 5) [резолюцию 41 \(ИС-76\)](#) «Процедуры для внесения поправок в Технический регламент (ВМО-№ 49), дополнения к нему, руководства и другие соответствующие нерегламентные публикации»,
- 6) [резолюцию 2 \(Кг-19\)](#) «Стратегический план ВМО на 2024—2027 годы»,
- 7) [резолюцию 20 \(Кг-19\)](#) «Руководящие указания высокого уровня по эволюции глобальных систем наблюдений в период 2023—2027 годов в ответ на Перспективное видение в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году»,
- 8) [резолюцию 21 \(Кг-19\)](#) «Осуществление Глобальной опорной сети наблюдений»,
- 9) [резолюцию 47 \(Кг-19\)](#) «Обязательные публикации ВМО и политика в области распространения на девятнадцатый финансовый период»,

отмечая [рекомендацию 4 \(ИНФКОМ-3\)](#) «Поправки к [Наставлению по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160)»,

отмечая также [резолюцию 4 \(ИНФКОМ-3\)](#) «[Руководство по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1165)»,

отмечая далее итоги семинара ВМО по базовым спутниковым данным (5—7 декабря 2023 года), а также то, что политика спутниковых операторов в отношении данных может отличаться и регулярно обсуждается в рамках Координационной группы по метеорологическим спутникам (КГМС),

рассматрив поправки к [Наставлению по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160), которые приводятся в дополнении к настоящей резолюции, и в особенности:

- 1) включение наблюдательного компонента для космической погоды;
- 2) включение вопросов, касающихся радиочастот (РЧ);
- 3) обновление принципов мониторинга климата в рамках Глобальной системы наблюдений за климатом;
- 4) разъяснение требований Глобальной опорной сети наблюдений (ГОСН);
- 5) корректировку структуры Региональной опорной сети наблюдений (РОСН);
- 6) включение основных и рекомендуемых спутниковых данных;
- 7) корректировку базового плана КГМС;
- 8) включение практики передачи сводок DAYCLI,

принимает поправки к [Наставлению по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160), которые приводятся в дополнении к настоящей резолюции;

уполномочивает Генерального секретаря вносить любые последующие поправки чисто редакционного характера;

просит Генерального секретаря:

- 1) опубликовать [Наставление по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160) на всех официальных языках ВМО;
- 2) обеспечить редакционную согласованность соответствующих документов;
- 3) довести настоящую резолюцию до сведения всех заинтересованных сторон;

поручает Комиссии по наблюдениям, инфраструктуре и информационным системам:

- 1) продолжить разработку и совершенствование, в сотрудничестве и консультации с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) и Советом по исследованиям по мере необходимости, [Технического регламента](#) (ВМО-№ 49), том I — Общие метеорологические стандарты и рекомендуемые практики, часть I — ИГСНВ, и [Наставления по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160), в частности в соответствии с [резолюцией 21 \(Кг-19\)](#);
- 2) оказывать Членам помощь в выполнении данных положений по мере необходимости.

Примечание: настоящая резолюция заменяет [резолюцию 18 \(ИС-76\)](#), которая более не имеет силы.

Более подробную информацию см. в документе INFCOM-3/INF. 8.1(1).

Дополнение к проекту резолюции №№/1 (ИС-78)

Поправки к Наставлению по Интегрированной глобальной системе наблюдений ВМО (ВМО-№ 1160)

Manual on the WMO Integrated Global Observing System

Annex VIII to the WMO Technical Regulations

Publication revision track record

Date	Part/chapter/section	Purpose of amendment	Proposed by	Approved by
	Definitions	Adjustment of "Drifting buoy" definition. Inclusion of the definition of Environmental sustainability	Secretariat	
	Chapter 1/1.2 and 1.2.5	Inclusion of the observing system for Space Weather	INFCOM/SC-ESMP/ET-SWx Secretariat	
	Chapter 1/1.3.1.6	"Should" changed to "shall"	INFCOM/SC-ON/ET-WTR and Secretariat	
	Chapter 2/2.3.1.5 and 2.3.1.6	Addition of the provisions on Radio Frequencies (RF), including on National Focal Points for RF matters	INFCOM/SC-ON/ET-RFC	
	Chapter 2/2.4.3	Editorial changes	Secretariat	
	Chapter 2/2.5.3	Editorial changes - clarification	Secretariat	
	Appendix 2.2	Update of GCOS Climate Monitoring Principles	GCOS	
	Appendix 2.3	Update of the Application Area names and adjustment of the note on Uncertainty	Secretariat	
	Attachment 2.2	New adding to the entities recognized as issuer of Identifier	INFCOM/SC-ON/ET-SSU and Secretariat	
	Attachment 2.4	Clarification of entities undertaking WDQMS	Secretariat	
	Chapter 3/3.2.1.1	Clarification of "surface station"	Secretariat	
	Chapter 3/3.2.2 3.2.2.7 note 3.2.2.10 note 3.2.2.15 note	Alignment with Resolution 21 (Cg-19) on GBON design, and - clarify the small island horizontal resolution for land	INFCOM/SC-ON/JET-EOSDE, TT-GBON, Next	

	<i>New 3.2.2.22bis</i>	<i>surface stations (3.2.2.7, 3.2.2.10, 3.2.2.15) - non-binding voluntary operation of GBON in areas of global commons, to allow further development of monitoring and targets for the High Seas and Antarctica</i>	<i>and Secretariat</i>	
	<i>Chapter 3/3.2.3</i>	<i>Adjustment of RBON provisions to avoid duplication with GBON provisions and to reflect the assignment process as per Resolution 21 (Cg-19)</i>	<i>INFCOM/SC-ON/JET-EOSDE and Secretariat</i>	
	<i>Appendix 3.1</i>	<i>Alignment with the new process for GBON assignment as per Resolution 21 (Cg-19).</i>	<i>INFCOM/SC-ON/JET-EOSDE and Secretariat</i>	
	<i>Attachment 3.1</i>	<i>Removal of the entire attachment as it does not represent regulatory material</i>	<i>INFCOM/SC-ON/JET-EOSDE and Secretariat</i>	
	<i>Chapter 4/4.5.1.2</i>	<i>Introduction of core and recommended satellite data</i>	<i>INFCOM/SC-ON/ET-SSU and Secretariat</i>	
	<i>Attachment 4.1</i>	<i>Significant reduction to provide reference to the regularly updated CGMS website.</i>	<i>INFCOM/SC-ON/ET-SSU and Secretariat</i>	
	<i>Attachment 4.2</i>	<i>New attachment on core and recommended satellite data</i>	<i>INFCOM/SC-ON/ET-SSU and Secretariat</i>	
	<i>Chapter 5/5.1.6 and 5.1.7</i>	<i>Reordering of the provisions to put "shall" one first. Adjustment of the notes.</i>	<i>Secretariat</i>	
	<i>Chapter 5/5.1.14</i>	<i>Inclusion of DAYCLI reporting practice and adjustment of the notes</i>	<i>SERCOM/SC-CLI/ET-DRC and Secretariat</i>	
	<i>Appendix 5.5/5.5.2</i>	<i>Alignment with Chapter 2, section 2.3</i>	<i>INFCOM/SC-ON/ET-RFC</i>	
	<i>Appendix 5.6/5.6.2</i>	<i>Alignment with Chapter 2, section 2.3</i>	<i>INFCOM/SC-ON/ET-RFC</i>	
	<i>Attachment 5.1</i>	<i>Clarification of the state of the ground, snow depth, sea ice and rate of ice accretion</i>	<i>Secretariat</i>	
	<i>Chapter 6/ 6.1.2 6.1.4 6.2.4 6.3.2</i>	<i>New note added to stress the difference regarding emerging operational systems. Adjustment with new RRR. Clarification of the validity of GAW. Implementation plan. Adding of other entities. Correction to the primary standard names.</i>		

INTRODUCTION

General

1. This is the fourth edition of the Manual on the WMO Integrated Global Observing System (WMO-No. 1160), which was approved by the WMO Executive Council at its seventy-sixth session. It replaces the third edition, which was approved by the World Meteorological Congress at its extraordinary session in 2021 in order to take into account the establishment of the Global Basic Observing Network, as well as the second edition, which was approved by the Eighteenth World Meteorological Congress. The first edition was issued following the decision of the Sixteenth Congress to proceed with the implementation of the WMO Integrated Global Observing System (WIGOS) and it was further developed in line with the decision of the Seventeenth Congress to proceed with the preoperational phase.

2. The Manual was developed by the Executive Council through its Inter-Commission Coordination Group on WIGOS, specifically its Task Team on WIGOS regulatory material. It is the result of a collaborative approach involving all interested technical commissions under the leadership of the former Commission for Basic Systems (CBS) and the former Commission for Instruments and Methods of Observation (CIMO).

Purpose and scope

3. The Manual is designed:

- (a) To specify the obligations of Members in the implementation and operation of WIGOS;
- (b) To facilitate cooperation in observations among Members;
- (c) To ensure adequate uniformity and standardization in the practices and procedures employed in achieving (a) and (b) above.

4. The Manual is Annex VIII to the *Technical Regulations* (WMO-No. 49) and should be read in conjunction with the three volumes and the set of annexes which together make up the *Technical Regulations*. Gradually, all technical regulations for all WMO component observing systems will be included in WIGOS.

5. Members will implement and operate their observing systems in accordance with decisions of Congress, the Executive Council, the technical commissions and regional associations. Where those decisions are technical and regulatory in nature, they will in due course be documented in the Technical Regulations.

6. In essence, the Manual specifies what is to be observed and what practices and procedures are to be followed in order to meet the relevant observational requirements of Members. These requirements may arise directly at a national level or collectively through WMO Programmes at global or regional levels, and are expressed through the application areas of the Rolling Review of Requirements. A number of other Manuals and Guides provide more practices and procedures on the operation of observing systems including stations and platforms, instruments and methods of observation, and on reporting and management of observations and observational metadata.

7. In the case of hydrological observations, there is not a widely implemented base of global exchange and global standard practices and procedures. Technical Regulations

(WMO-No. 49), Volume III, provides Members with predominantly recommended practices and procedures. In order to help ensure the quality and comparability of observations within WIGOS, Members making their hydrological observations available through the WMO Hydrological Observing System (WHOS) are requested to comply with the provisions specified within the present Manual. For this reason, a number of provisions that are recommended practices and procedures for hydrology in *Technical Regulations*, Volume III, are listed as standard practices and procedures in the present Manual. It is recognized that it might not be easy for some of the WIGOS standard practices and procedures to be widely and quickly implemented by all Members for their hydrological observations. Nonetheless, Members are urged to do their best to implement the WIGOS standard practices and procedures in the collection and exchange of hydrological observations and to make such observations available through WHOS.

Appendices

8. Appendices are used where a set of provisions on a single topic might, due to its detailed nature and length, otherwise interrupt the flow of the relevant section of the present Manual. Moreover, appendices are used to facilitate the ongoing review and update process by identifying subsections that fall under the responsibility of a particular group.

Notes:

1. The General Provisions to the Technical Regulations, formerly reproduced as a part of the present manual, can be found in the publication Technical Regulations (WMO-No. 49), Volume I – General Meteorological Standards and Recommended Practices.
2. The former appendix to the General Provisions, entitled "Procedures for amending WMO manuals and guides that are the responsibility of the Commission for Observation, Infrastructure and Information Systems", previously a part of the present manual, has been updated and can be found in the publication Rules of Procedure for Technical Commissions (WMO-No. 1240), Annex VII.

DEFINITIONS

Notes:

1. Definitions of other terms related to observing systems may be found in the Technical Regulations (WMO-No. 49), Volume I. Since definitions are not repeated, the reader is advised to consult this section and the corresponding one in *Technical Regulations*, Volume I.
2. Further definitions may be found in the *Manual on Codes* (WMO-No. 306), ~~Volumes I-1, I-2 and I-3,~~ the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485), the Manual on the Global Telecommunication System (WMO-No. 386) and other WMO publications.
3. The definitions, terminology, vocabulary and abbreviations used in relation to quality management are those of the International Organization for Standardization (ISO) 9000 family of standards for quality management systems, in particular those identified within ISO 9000:2015, *Quality management systems – Fundamentals and vocabulary*.
4. It is intended that any definition related to traceability and calibration is consistent with the *International Vocabulary of Metrology – Basic and General Concept and Associated Terms*, JCGM 200:2012, (known by its French acronym, VIM) of the International Bureau of Weights and Measures (known by its French name, Bureau International des Poids et Mesures (BIPM)).

The following terms, when used in the present Manual, have the meanings given below.

Accuracy. The extent to which the results of the readings of an instrument approach the true value of the calculated or measured quantities, supposing that all possible corrections are applied.

Acoustic Doppler current profiler (ADCP). A hydroacoustic device to measure the velocity of water over a range of depths in a column using the Doppler effect, with the overall depth of water usually being measured simultaneously.

Acoustic velocity meter. A system that uses the difference in travel time of acoustic (ultrasonic) pulses between transducers in a stream to determine the mean velocity on the signal path.

Actual time of observation: (a) In the case of a surface synoptic observation, the time at which the barometer is read; (b) In the case of upper-air observations, the time at which the balloon, parachute or rocket is actually released.

Adaptive maintenance. Modification of an instrument, software or other product, performed after installation to keep it usable in a changed or changing environment.

Aeronautical meteorological station. A station designated to make observations and meteorological reports for use in international air navigation.

Agricultural meteorological station. A station that provides meteorological data for agricultural and biological purposes, and makes other meteorological observations under programmes of agrometeorological research centres and other relevant organizations.

Aircraft Meteorological Data Relay (AMDAR). An automated system for the collection of aviation meteorological data from aircraft.

Aircraft meteorological station. See Technical Regulations (WMO-No. 49), Volume I.

Aircraft weather reconnaissance flights. An aircraft flight for the specific purpose of making observations.

Automatic station. An observing station at which instruments make and transmit observations, the conversion to code form for international exchange being made either directly or at an editing station.

Bank. (a) Rising land bordering a river, usually to contain the stream within the wetted perimeter of the channel; (b) Margin of a channel on the left-hand (right-hand) side when facing downstream.

BUFR. The Binary Universal Form for the Representation of meteorological data; a binary data format.

Cableway. A cable stretched above and across a stream, from which a current meter or other measuring or sampling device is suspended and moved from one bank to the other, at predetermined depths below the water surface.

Calibration (rating) tank (straight open tank). A tank containing still water through which a current meter is moved at a known velocity in order to calibrate the meter.

Catchment area. An area having a common outlet for its surface runoff.

Certification. The provision by an independent body of written assurance (a certificate) that the product, service or system in question meets specific requirements.

Climatological station. A station whose observations are used for climatological purposes.

Coastal station. An observing station on the coast that makes both surface land observations and surface marine observations.

Compliance. Adherence to an internal code of conduct where employees follow the principles of one of the quality management standards series (such as the ISO standards) or other internationally recognized practices and procedures. It could also be an external stamp of approval by an accreditation firm when customers or partners request documented proof of compliance.

Confidence level. Probability that the confidence interval includes the true value.

Control. Physical properties of a channel which determine the relationship between stage and discharge at a location in the channel.

Control structures. Artificial structures placed in a stream, such as a low weir or flume, to stabilize the stage-discharge relation, particularly in the low-flow range, where such structures are calibrated by stage and discharge measurements taken in the field.

Co-sponsored observing system. An observing system in which some but not all observations are WMO observations.

CryoNet. The core component of the WMO Global Cryosphere Watch (GCW) surface observing network.

CryoNet cluster. A component of CryoNet comprising two or more coordinated stations, of which at least one must be a CryoNet station or a CryoNet contributing station together with a station providing representative meteorological observations, and which together, meet the requirements for a CryoNet station.

CryoNet contributing station. A GCW station that provides useful measurements of the cryosphere but does not meet all requirements for a CryoNet station.

CryoNet station. A GCW station measuring at least one variable of one cryosphere component, and meeting a set of defined requirements.

Cross-section. A section perpendicular to the main direction of flow bounded by the free surface and wetted perimeter of the stream or channel.

Current meter. An instrument for measuring water velocity.

Current meter, propeller type. A current meter the rotor of which is a propeller rotating around an axis parallel to the flow.

Data archiving. Storage of data on a set of catalogued files which are held in some backup storage medium and not necessarily permanently online.

Data compatibility. The capacity for two systems to exchange data without having to be altered to do so and without any need for changes in data formats.

Data processing. Treatment of observational data until they are in a form ready to be used for a specific purpose.

Data quality objectives. Definition of the type, quality and quantity of primary data and derived parameters required to yield information that can be used to support decisions.

Discharge. Volume of water flowing through a river (or channel) cross-section per unit time.

Drainage basin. See **catchment area**.

Drifting buoy. A floating automatic station that is free to drift under the influence of current or wind and ~~current~~wave.

Elevation. The vertical distance of a point or level, on or affixed to the surface of the ground, measured from mean sea level.

Environmental Sustainability. It refers to the practice of conserving, maintaining and protecting global ecosystems while planning observing systems across all domains without adding unnecessary strain on ecosystems.

Flood. (a) A rise, usually brief, in the water level of a stream or water body to a peak from which the water level recedes at a slower rate; (b) A relatively high flow as measured by stage height or discharge.

Flood-proofing. Techniques for preventing flood damage in a flood-prone area.

Gauge boards (staff gauges). Graduated vertical scales, fixed to a staff or structure, on which the water level may be read.

Gauge datum. The vertical distance between the zero of a gauge and a certain datum level.

Gauging station. Location on a stream where measurements of water level and/or discharge are made systematically.

Global Climate Observing System (GCOS) Reference Upper-air Network (GRUAN) station. An upper-air station included in the network of stations specially selected and certified to provide long-term high-quality climate records.

Global Climate Observing System (GCOS) Surface Network (GSN) station. A land station included in the specially selected network of stations to monitor daily and large-scale climate variability on a global basis.

Global Climate Observing System (GCOS) Upper-air Network (GUAN) station. An upper-air station included in the specially selected global baseline network of upper-air stations to meet GCOS requirements.

Global Cryosphere Watch (GCW) affiliated network. A network of stations measuring at least one cryospheric variable, contributing to GCW in addition to CryoNet and CryoNet contributing stations.

Global Cryosphere Watch (GCW) station. A station that measures and reports one or more variables of one or more components of the cryosphere.

Hydrograph. A graph showing the variation in time of some hydrological data such as stage, discharge, velocity and sediment load.

Hydrological forecast. An estimation of the magnitude and time of occurrence of future hydrological events for a specified period and for a specified locality.

Hydrological observation. A direct measurement or evaluation of one or more hydrological elements such as stage, discharge and water temperature.

Hydrological observing station. A place where hydrological observations or climatological observations for hydrological purposes are made.

Hydrological warning. Emergency information on an expected hydrological event that is considered to be dangerous.

Hydrometric station. A station gathering data on one or more parameters of water in rivers, lakes or reservoirs, such as stage, streamflow, sediment transport and deposition, water temperature and other physical or chemical properties of water, and characteristics of ice cover.

Intercomparison. A formalized process to assess the relative performance of two or more systems (observing, forecasting, etc.).

Mobile sea station. A station aboard a mobile ship or an ice floe.

Moving-boat method. A method of measuring discharge that uses a boat to traverse the stream along the measuring section and continuously measure velocity, depth and distance travelled.

Quality. The degree to which a set of inherent characteristics fulfils requirements.

Quality assurance. That part of quality management focused on providing confidence that quality requirements will be fulfilled.

Quality control. That part of quality management focused on fulfilling quality requirements.

Quality management. The coordinated activities that direct and manage an organization with respect to quality.

Observing facility. An observing station or platform.

Planetary boundary layer. The lowest layer in the atmosphere, usually taken to be up to 1 500 m, in which meteorological conditions are affected significantly by the Earth's surface.

Planetary boundary-layer observation. An observation of the planetary boundary layer.

Present and past weather. The qualitative description of observable phenomena, at the time of observation or during a preceding period.

Note: Relevant observable phenomena in the atmosphere include precipitation, suspended or blowing particles, and other designated optical phenomena or electrical manifestations, as described in the International Cloud Atlas: Manual on the Observation of Clouds and Other Meteors (WMO-No. 407), the Guide to Instruments and Methods of Observation (WMO-No. 8) and, for aeronautical applications, in the Technical Regulations (WMO-No. 49), Volume II.

Radar wind profiler observation. See Technical Regulations (WMO-No. 49), Volume I.

Radar wind profiler station. See Technical Regulations (WMO-No. 49), Volume I.

Radiation station. A station at which observations of radiation are made:

- (a) **Principal radiation station.** A radiation station whose observing programme includes at least the continuous recording of global solar radiation and sky radiation, and regular measurements of direct solar radiation;
- (b) **Ordinary radiation station.** A radiation station whose observing programme includes at least the continuous recording of global solar radiation.

Radiosonde station. A station at which observations of atmospheric pressure, temperature and humidity in the upper air are made by electronic means.

Rating curve. A curve showing the relation between stage and discharge of a stream at a hydrometric station.

Recession. The period of decreasing discharge as indicated by the falling limb of a hydrograph starting from the peak.

Reference climatological station. A climatological station gathering data intended for the purpose of determining climatic trends.

Note: This requires long periods (not less than 30 years) of homogeneous records, where human-induced environmental changes have been and/or are expected to remain at a minimum. Ideally, the records should be of sufficient length to enable the identification of secular changes of climate.

Regional Basic Observing Network (RBON). A network of surface-based meteorological, hydrological and related observing stations/platforms defined and adopted by the relevant WMO regional association, or the Executive Council or the World Meteorological Congress.

Regional Meteorological Centre (RMC). A centre of the WMO Integrated Processing and Prediction System whose primary purpose is to issue meteorological analyses and prognoses on a regional scale.

Registration. Certification is very often referred to as registration in North America.

Research and special-purpose vessel station. A vessel making voyages for scientific research or marine monitoring purposes, which is recruited to make meteorological observations during the voyages.

Reservoir. A body of water, either natural or man-made, used for storage, regulation and control of water resources.

River. A large stream that serves as the natural drainage for a basin.

Sea station. A station situated at sea which makes surface marine observations. Sea stations include ships and stations on fixed or drifting platforms.

Note: Such a station may also make subsurface observations in accordance with Intergovernmental Oceanographic Commission (IOC) regulations.

Special report. A report made at a non-standard time of observation when specified conditions or changes of conditions occur.

Stage. See **water level**.

Stage-discharge relation. The relationship between water level and discharge for a river cross-section, which may be expressed as a curve, a table or an equation.

Standard time of observation (standard time). A time specified for making meteorological observations:

- (a) Main standard times: 0000, 0600, 1200, 1800 UTC;
- (b) Intermediate standard times: 0300, 0900, 1500 and 2100 UTC;
- (c) Additional standard times: 0100, 0200, 0400, 0500, 0700, 0800, 1000, 1100, 1300, 1400, 1600, 1700, 1900, 2000, 2200, 2300 UTC.

Sunshine duration. The total time in one day during which the direct solar irradiance is equal to or more than the threshold value for bright sunshine (the threshold being 120 W m^{-2} of direct solar irradiance).

Surface land station, surface marine station. See Technical Regulations (WMO-No. 49), Volume I.

Surface observation, surface land observation, surface marine observation. See Technical Regulations (WMO-No. 49), Volume I.

Streamflow. A general term for water flowing in a watercourse.

Synoptic observation. A specified basic set of meteorological information collected at a standard time of observation.

Upper-air observation. See Technical Regulations (WMO-No. 49), Volume I.

Upper-air station. See Technical Regulations (WMO-No. 49), Volume I.

Uncertainty. An estimate of the range of values within which the true value of a variable lies.

Upstream. The direction from which a fluid is moving.

User requirements for observations. Requirements for geophysical variables expressed in terms of up to eight criteria: uncertainty, horizontal resolution, vertical resolution, observing cycle, timeliness, stability, layer/s quality and coverage quality, including relative priority for each of them. For each of these criteria, three values are determined:

- (a) The **goal** is an ideal requirement above which further improvements are not necessary;
- (b) The **threshold** is the minimum requirement to be met to ensure that data are useful,
- (c) The **breakthrough** is an intermediate level between **threshold** and **goal** which, if achieved, would result in a significant improvement for the targeted application.

Verification. The process of establishing the truth, accuracy or validity of something.

Water level. The elevation of the free water surface of a water body relative to a datum level.

Weather radar observation. See Technical Regulations (WMO-No. 49), Volume I.

Weather radar station. See Technical Regulations (WMO-No. 49), Volume I.

1. INTRODUCTION TO THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM

1.1 PURPOSE AND SCOPE

1.1.1 The WMO Integrated Global Observing System (WIGOS) shall be a framework for all WMO observing systems and for WMO contributions to co-sponsored observing systems in support of all WMO Programmes and activities.

Note: The co-sponsored observing systems are the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS), which are joint undertakings of WMO and the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP) and the International Science Council (ISC).

1.1.2 The WMO Integrated Global Observing System shall facilitate the use by WMO Members of observations from systems that are owned, managed and operated by a diverse array of organizations and programmes.

1.1.3 The principal purpose of WIGOS shall be to meet the evolving requirements of Members for observations.

1.1.4 The interoperability (including data compatibility) of WIGOS component observing systems shall be achieved through their common utilization and application of internationally accepted standards and recommended practices and procedures.

Note: The relevant standards include data representation standards.

1.2 WIGOS COMPONENT OBSERVING SYSTEMS

The component observing systems of WIGOS shall comprise the Global Observing System (GOS) of the World Weather Watch (WWW) Programme, the observing

component of the Global Atmosphere Watch (GAW) Programme, the WMO Hydrological Observing System (WHOS) of the Hydrology and Water Resources Programme (HWRP) ~~and~~, the observing component of the Global Cryosphere Watch (GCW), and the observing system for Space Weather, including their surface-based and space-based elements.

Note: The above component systems include all WMO contributions to the co-sponsored systems, the Global Framework for Climate Services (GFCS) and the Global Earth Observation System of Systems (GEOSS).

1.2.1 The Global Observing System of the World Weather Watch

1.2.1.1 The Global Observing System shall be a coordinated system of observing networks, methods, techniques, facilities and arrangements for making observations on a worldwide scale, and shall be one of the main components of the World Weather Watch.

1.2.1.2 The purpose of GOS shall be to provide the meteorological observations from all parts of the globe that are required by Members for operational and research purposes through all WMO and co-sponsored programmes.

1.2.1.3 The Global Observing System shall consist of: (a) a surface-based subsystem composed of regional basic and other networks of stations and platforms; and (b) a space-based subsystem composed of: (i) an Earth observation space segment; (ii) an associated ground system for data reception, dissemination and stewardship; and (iii) a user segment.

1.2.1.4 The Global Observing System shall comply with the provisions specified in sections 1, 2, 3, 4 and 5 of this Manual.

1.2.2 The observing component of the Global Atmosphere Watch

1.2.2.1 The Global Atmosphere Watch shall be a coordinated system of observing networks, methods, techniques, facilities and arrangements encompassing the many monitoring activities and scientific assessments devoted to the investigation of the chemical composition and related physical characteristics of the atmosphere.

Note: The GAW Programme has six focal areas: ozone, greenhouse gases, reactive gases, aerosols, ultraviolet (UV) radiation and total atmospheric deposition. The GAW stations, in addition to measuring one or more of the parameters related to these areas, may also measure ancillary variables such as radiation, radio nuclides and persistent organic pollutants.

1.2.2.2 The purpose of GAW shall be to provide data and other information on the chemical composition and related physical characteristics of the atmosphere to support multiple applications, as defined in section 6, in all parts of the globe. This is intended to reduce environmental risks to society, meet the requirements of environmental conventions, strengthen capabilities to predict the state of climate, weather and air quality, and contribute to scientific assessments in support of environmental policy.

1.2.2.3 The observing component of GAW shall consist of a surface-based system comprising networks for the observation of specified variables, complemented by space-based observations.

1.2.2.4 The observing component of the GAW Programme shall be operated in accordance with the provisions specified in sections 1, 2, 3, 4 and 6 of this Manual.

1.2.3 The WMO Hydrological Observing System

1.2.3.1 The WMO Hydrological Observing System shall comprise hydrological observations.

Note: The composition of WHOS will be provided in a future edition of the Technical Regulations (WMO-No. 49), Volume III: Hydrology.

1.2.3.2 The WMO Hydrological Observing System shall expand to include other elements identified through the Rolling Review of Requirements (RRR) (described in section 2.2.4 and Appendix 2.3) at the national, regional and global levels.

1.2.3.3 The purpose of WHOS shall be to provide a fully WMO Information System (WIS)-compliant services-oriented framework linking hydrologic data providers and users through a hydrologic information system enabling data registration, discovery and access.

1.2.3.4 Members making their hydrological observations available through the WHOS shall comply with the provisions specified in sections 1, 2, 3, 4 and 7 of this Manual.

Note: The Technical Regulations (WMO-No. 49), Volume III, the Guide to Hydrological Practices (WMO-No. 168), Volume I, the Manual on Stream Gauging (WMO-No. 1044), Volume I, and the Manual on Flood Forecasting and Warning (WMO-No. 1072) provide the necessary information to operate hydrological stations to the prescribed standards.

1.2.4 The observing component of the Global Cryosphere Watch

1.2.4.1 The observing component of GCW shall be a coordinated system of observing stations and platforms, methods, techniques, facilities and arrangements encompassing monitoring activities and related scientific assessments of the cryosphere.

1.2.4.2 The purpose of the observing component of GCW shall be to provide observations and other information on the cryosphere, from the local to the global scale, and to improve understanding of its behaviour, interactions with other components of the Earth's system, and impacts on society.

1.2.4.3 The GCW surface observing network and its core network, CryoNet, should lead the standardization and coordination of cryospheric observations among existing programmes and networks according to GCW best practices.

Note: In fulfilling this role, the GCW surface observing network will support the incorporation of cryospheric observations into shared data products and services.

1.2.4.4 Members making cryospheric observations shall comply with the provisions specified in sections 1, 2, 3, 4 and 8 of this Manual.

1.2.5 The observing system for Space Weather

1.2.5.1 The observing system for Space Weather shall be a coordinated system of observing networks, methods, techniques, facilities and arrangements encompassing the monitoring of the solar activity, as well as its impacts on geospace, atmosphere and the Earth surface.

1.2.5.2 The purpose of the observing system for Space Weather shall be to provide the necessary observations from all parts of the globe that are required by Members for their operational Space Weather services.

1.2.5.3 The observing system for Space Weather shall consist of surfacebased systems as well as spacebased systems.

1.2.5.4 The observation system for Space Weather should lead to standardization and coordination of Space Weather observations across existing programmes and networks.

1.3 GOVERNANCE AND MANAGEMENT

1.3.1 Implementation and operation of WIGOS

1.3.1.1 Members shall be responsible for all activities connected with the implementation and operation of WIGOS on the territory of their respective countries.

1.3.1.2 Members should, as far as possible, use national resources for the implementation and operation of WIGOS but, where necessary and if so requested, assistance may be provided in part through:

- (a) The WMO Voluntary Cooperation Programme (VCP);
- (b) Other bilateral or multilateral arrangements and facilities including the United Nations Development Programme (UNDP), which should be used to the maximum extent possible.

1.3.1.3 Members should participate voluntarily in the implementation and operation of WIGOS outside the territories of individual countries (for example, outer space, oceans and the Antarctic), if they wish and are able to contribute by providing facilities and services, either individually or jointly.

1.3.1.4 Members should actively participate in the establishment and operation of the Regional WIGOS Centres (RWCs) as a critical contribution to the implementation and operation of WIGOS.

1.3.1.5 Members hosting and operating an RWC shall arrange for the centre to carry out operationally at least the mandatory functions: (1) WIGOS metadata management; and (2) WIGOS performance monitoring, evaluation and incident management.

Note: Further details on the establishment and operation of RWCs are provided in the Guide to the WMO Integrated Global Observing System (WMO-No. 1165), Chapter 8.

1.3.1.6 Members operating an RWC ~~should~~ shall comply with the principles and objectives of the corresponding RWC implementation stages.

Note: See Note under 1.3.1.5

1.3.2 WIGOS quality management

Notes:

1. Within the WMO Quality Management Framework (QMF), WIGOS provides the procedures and practices regarding the quality of observations and observational metadata to be adopted by Members in establishing their quality management system for the provision of meteorological, hydrological, climatological and other related environmental observations.
2. Section 2.6 contains detailed provisions for WIGOS quality management.

1.3.3 WIGOS high-level processes

Members should adopt a process-based approach to the management of WIGOS as described in Attachment 1.1.

ATTACHMENT 1.1. WIGOS HIGH-LEVEL PROCESSES

Many of the WIGOS activities may be represented as a series of high-level processes.

~~The~~ Figure 1.1 below provides a schematic description of the processes (horizontal bars), the collaborating entities (columns) and those primarily involved in each process (marked by solid

circles). In reality, the processes have more complex interrelationships and sequences than shown by the arrows – the most extreme case being capacity development (including training) which is not shown as a step in the sequence since it provides important inputs to most of the other processes.

Figure 1.1. Schematic representation of WIGOS high-level processes

These processes are carried out by Members through one of the following modes of collaboration:

- Data users in application areas: Members collaborate by selectively contributing application experts and information;
- WMO regional associations: Members collaborate by working together in a geographical grouping and by selectively contributing experts for regional teams;
- WMO technical commissions: Members collaborate by selectively contributing technical experts for global teams;
- As individual operators and managers of observing systems, Members directly undertake the relevant WIGOS process(es);
- WMO designated centres for performance monitoring (including lead centres and monitoring centres): individual Members or groups of Members operate a WMO centre designated for performance monitoring.

In the case of WIGOS processes being undertaken by the WMO Secretariat or other entities funded by WMO Programmes, the mode of collaboration is through the overall operation of WMO.

The relationship between WIGOS high-level processes and the structure of the regulatory material is shown below: the standard and recommended practices and procedures relevant to each WIGOS process can be found in section 2, as indicated:

- Determination of user requirements: 2.1 and 2.2;
- Design, planning and evolution of WIGOS: 2.2;
- Development and documentation of standards and recommendations for observing systems: 2.3;
- Implementation of an observing system by owners and operators: 2.3 and 2.4;
- Observing system operation and maintenance, including fault management and audit: 2.4;
- Observation quality control: 2.4 and 2.6;
- Delivery of observations and observational metadata: 2.4 and 2.5;
- Performance monitoring: 2.4 and 2.6;
- User feedback and review of requirements: 2.2.4, 2.6.3.5 and Appendix 2.3;
- Capacity development (including training): 2.7.

2. COMMON ATTRIBUTES OF WIGOS COMPONENT SYSTEMS

2.1 USER REQUIREMENTS

2.1.1 Members shall take steps to collect, record, review, update and make available their user requirements for observations.

2.1.2 Members shall convey their user observational requirements, for each of the WMO application areas, to the RRR process described under section 2.2.4 and Appendix 2.3.

2.2 DESIGN, PLANNING AND EVOLUTION

2.2.1 General

2.2.1.1 Members shall design WIGOS as a flexible and evolving system capable of continuous improvement.

Note: Factors that drive the evolution of WIGOS component observing systems include technological and scientific progress and costeffectiveness; changes in the needs and requirements of WMO, WMO cosponsored programmes and international partner organizations at national, regional and global levels; and changes in the capacity of Members to implement observing systems. It is important to identify the impact on all users before a change is made.

2.2.1.2 Members shall plan and operate their networks in a sustainable and reliable manner using WIGOS standard and recommended practices and procedures, and tools.

Note: Sustainability over at least a tenyear period is recommended; however, this depends on paying sufficient attention to maintenance and operations following the establishment of the network.

2.2.2 Principles for observing network design and planning

2.2.2.1 *Observing network design principles*

2.2.2.1.1 Members should follow the principles specified in Appendix 2.1 when designing and developing their observing networks.

2.2.2.1.2 Members should conduct network design studies that address national, regional and global scale questions about the optimum affordable mix of components to best satisfy the requirements for observations.

2.2.2.2 *Climate monitoring principles of the Global Climate Observing System*

Members designing and operating observing systems for monitoring the climate should adhere to the principles specified in Appendix 2.2.

Note: Fiftyfive Essential Climate Variables have been identified for GCOS. These are required to support the work of the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC). The Essential Climate Variables cover the atmospheric, oceanic and terrestrial domains, and all are technically and economically feasible for systematic observation. Further information about the Essential Climate Variables can be found in The 2022 GCOS Implementation Plan (GCOS-244) and The 2022 GCOS ECVs Requirements (GCOS-245).

2.2.2.3 *Observations in special circumstances*

Members should operate their observing systems with the capacity to adapt to and target the special requirements that arise under special circumstances.

Note: Several WMO application areas require specific observations under special circumstances. Attachment 2.1. provides further details of specific requirements in several special circumstances. Provisions relating to satellite rapid scans and other special observations also appear in subsequent sections of this Manual.

2.2.3 Vision for WIGOS

Members shall take into account the *Vision for WIGOS in 2040* when planning the evolution of their observing networks.

Note: The Vision for WIGOS in 2040 (WMO-No. 1243) provides highlevel goals to guide the evolution of WIGOS in the coming decades and is updated on a multiyear timescale (typically decadal).

2.2.4 The Rolling Review of Requirements

Members, both directly and through the participation of their experts in the activities of regional associations and technical commissions, shall contribute to the RRR process and assist the designated Points of Contact for each application area in performing their roles in the RRR.

Note: Appendix 2.3 provides further details on the RRR process.

2.2.5 Observation impact studies

2.2.5.1 Members, or groups of Members within regions, should conduct or participate in observation impact studies and related scientific evaluations to address WIGOS network design questions.

2.2.5.2 Members should provide expertise for synthesizing the results of impact studies and making recommendations on the best mix of observing systems to address the gaps identified by the RRR process.

Note: Observing system experiments, observing system simulation experiments, studies of forecast sensitivity to observations, and other tools are used to assess the impact of the various observing systems on Numerical Weather Prediction model analyses and predictions, hence their value and relative priority for addition or retention in these application areas.

2.2.6 Evolution of WIGOS component observing systems

2.2.6.1 Members should follow the plans published by WMO for the evolution of WIGOS component observing systems when planning and managing their observing systems.

Notes:

1. The planning and coordination of the evolution of WIGOS component observing systems is steered by the Executive Council and undertaken by Members individually and through regional associations, technical commissions and the relevant steering bodies of WMO cosponsored observing systems.
2. The current WMO guidance for the evolution of WIGOS component observing systems is provided in the *High-level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WMO Integrated Global Observing System (WIGOS) in 2040*. It contains guidelines and recommended actions to be undertaken by Members, technical commissions, regional associations, satellite operators and other relevant parties in order to stimulate the costeffective evolution of the WMO observing systems and address in an integrated way the requirements of WMO Programmes and cosponsored programmes.
3. The WMO guidance for the evolution of WIGOS observing systems is regularly updated, based on the RRR Statements of Guidance and taking into account the vision for the WIGOS component observing systems, the advice of the technical commissions and regional associations concerned, relevant WMO cosponsored observing systems and international experts in all application areas. The current version applies to the five year period 2023–2027.

2.2.6.2 Members shall coordinate the activities of organizations within their territory, including National Meteorological and Hydrological Services (NMHSs), academia, research institutions, ministries of environment, ocean communities, and

related agencies, in addressing relevant actions of WMO plans for the evolution of WIGOS observing systems.

2.2.6.3 Where Members cover small areas and are geographically close or have already established multilateral working relationships, they should consider a subregional or transboundary river basin approach, in addition to a national one, in planning WIGOS observing systems.

2.2.6.4 In such cases, the Members concerned should work in close cooperation to prepare subregional or transboundary river basin reviews of requirements to be used as a basis for detailed planning at that scale.

2.2.7 Monitoring the evolution of WIGOS component observing systems

Members should contribute to the monitoring of the evolution of WIGOS component observing systems by providing their national progress reports on a yearly basis through nominated national focal points.

Note: The Commission for Observation, Infrastructure and Information Systems (INFCOM), in collaboration with the Commission for Weather, Climate, Hydrological, Marine and Related Environmental Services and Applications (SERCOM) and the Research Board, regional associations, and cosponsored programmes, regularly reviews progress in the evolution of WIGOS component observing systems and provides updated guidance to Members thereon.

2.3 INSTRUMENTATION AND METHODS OF OBSERVATION

2.3.1 General requirements

Note: Details are provided in the Technical Regulations (WMO-No. 49), Volume III, the Guide to Instruments and Methods of Observation (WMO-No. 8), and the Guide to Hydrological Practices (WMO-No. 168), Volume I.

2.3.1.1 Members shall ensure that observations are traceable to the International System of Units (Système international d'unités (SI)) standards, where these exist.

Notes:

1. Traceability to SI standards is an area where concerted effort is required to increase or improve compliance.
2. It is also desirable that observational metadata are similarly traceable wherever possible.

2.3.1.2 Members shall use properly calibrated instruments and sensors that provide observations satisfying at least measurement uncertainties that meet the specified requirements, including for emerging technologies.

Notes:

1. Achievable measurement uncertainty is specified in the Guide to Instruments and Methods of Observation (WMO-No. 8), Volume I, Chapter 1, 1.6.4.2, and Annex 1.A.
2. A number of operational, financial, environmental and instrumental issues may in some cases prevent the system from satisfying the specified requirements. The Guide to Instruments and Methods of Observation (WMO-No. 8), Volume I, Annex 1.A (see the column "Achievable measurement uncertainty") provides a list of the achievable and affordable measurement uncertainties that in some cases might not satisfy specified requirements.
3. The strategy for traceability assurance, *described in the* Guide to Instruments and Methods of Observation (WMO-No. 8), Volume I, Annex 1.B, provides further guidance.

2.3.1.3 Members should describe uncertainty of observations and observational metadata as specified in the Guide to Instruments and Methods of Observation (WMO-No. 8), Volume I, Chapter 1, 1.6.

Notes:

1. The corresponding text from the Guide to Instruments and Methods of Observation (WMO-No. 8), Volume I, Chapter 1, 1.6, will be included as an appendix in a future edition of the present Manual.

2. The definition of uncertainty given in the *Guide to Instruments and Methods of Observation* (WMO No. 8), Volume I, Chapter 1, 1.6, is consistent with the international standards approved by the International Committee for Weights and Measures (Comité international des poids et mesures (CIPM)).
3. The traceability chain within the GAW Programme is defined in the *WMO Global Atmosphere Watch (GAW) Implementation Plan: 2016–2023* (GAW Report No. 228).

2.3.1.4 Members should follow the definitions and specifications for the calculation of derived observations given in the WMO Technical Regulations.

Notes:

1. Further methods provided or referenced by the *Guide to Instruments and Methods of Observation* (WMO No. 8) and the *Guide to Hydrological Practices* (WMO No. 168), Volume I, could also be considered.
2. Such derivations can take many forms, for example, statistical processing of average or smooth values, or multivariate algorithm to determine streamflow discharge.
3. The corresponding text from the *Guide to Instruments and Methods of Observation* (WMO No. 8) will be included as an appendix in a future edition of the present Manual.

2.3.1.5 Members operating instruments and sensors reliant on radio spectrum shall comply with national/international regulations for the use of radio frequencies.

Notes:

1. Extensive information about the use of radio frequencies can be found in the Handbook on Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction (WMO No. 1197).
2. Further information is provided in the Guide to Participation in Radio-frequency Coordination (WMO No. 1159) as well as in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume III.

2.3.1.6 Members should designate national focal points for radio frequency matters responsible for engaging with their respective national regulatory authorities to ensure that they have a comprehensive understanding of the importance of and requirements on radio frequencies for meteorological and related environmental activities.

2.4 OPERATIONS

2.4.1 General requirements

Note: Provision 2.4.1.1 of the Technical Regulations (WMO No. 49), Volume I, Part I, applies.

2.4.1.1 WMO observing stations and platforms shall be uniquely identified by a WIGOS station identifier.

Note: The structure of WIGOS station identifiers is specified in Attachment 2.2.

2.4.1.2 Members shall issue WIGOS station identifiers for observing stations and platforms within their geographic area of responsibility that contribute to a WMO or co-sponsored programme, and shall ensure that no WIGOS station identifier is issued to more than one station.

Notes:

1. Members may issue WIGOS station identifiers for observing stations and platforms within their geographic area of responsibility that do not contribute to a WMO or cosponsored programme, provided that the operator has committed to providing and maintaining WIGOS metadata.
2. For surface marine stations or sea stations contributing to the cosponsored GOOS OceanOPS (formerly JCOMMOPS) is authorized to issue WIGOS station identifiers on behalf of Members when asked to do so.
3. In line with the regulations under the Antarctic Treaty System, Members are authorized to issue WIGOS station identifiers for the stations/platforms they operate in Antarctica.

2.4.1.3 Before issuing a WIGOS station identifier, Members should ensure that the operator of a station or platform has committed to providing and maintaining WIGOS metadata for that station or platform.

Notes:

1. A WIGOS station identifier may be issued by an entity with delegated authority (listed in Attachment 2.2) hereafter referred to as "WSI issuers", for observing stations that contribute to a WMO or cosponsored programme on behalf of Members under the following circumstances (the relevant procedures are described in the Guide to the WMO Integrated Global Observing System (WMONo. 1165)):
 - 1.1 When a WIGOS station identifier is required for a station or platform to support a WMO or cosponsored programme and no Member is in a position to issue one, the SecretaryGeneral may issue a WIGOS station identifier for that station or platform, using the "issuer of identifier" allocated to the SecretaryGeneral, provided that the operator of the station or platform has committed to:
 - (a) Providing WIGOS metadata;
 - (b) Conforming to relevant Technical Regulations.
 - 1.2 When a WIGOS station identifier is required for a station or platform to support a WMO or cosponsored programme and a Member is not able to issue one, the WSI issuer will issue a WIGOS station identifier for that station or platform, provided that its operator has committed to:
 - (a) Providing WIGOS metadata;
 - (b) Conforming to relevant Technical Regulations.
 - 1.3 When a WIGOS station identifier is requested by the operator of a station or platform that contributes to a WMO or cosponsored programme and the Member concerned has neither issued the identifier nor provided a valid reason for nonissuance, the WSI issuer will issue an identifier provided that its operator has committed to:
 - (a) Providing WIGOS metadata;
 - (b) Conforming to relevant Technical Regulations.
2. In all cases of 1.1 to 1.3 above, where a WIGOS station identifier is issued by an authority other than the Permanent Representative of the respective Member with WMO of the country or territory in which the station is operating, the Permanent Representative of the respective Member with WMO will be informed in writing by the SecretaryGeneral and will be given a period of no less than 30 days to reverse this assignment if they believe they have a valid reason for doing so.

2.4.1.4 Members shall make available to WMO the updated metadata each time a new WIGOS station identifier is issued.

2.4.1.5 Members shall operate their observing systems with properly calibrated instruments and adequate observing and measuring techniques.

Notes:

1. Detailed guidance on observing practices for meteorological observing systems and instruments is given in the Guide to Instruments and Methods of Observation (WMONo. 8).
2. Detailed guidance on observing practices for hydrological observing systems and instruments is given in the Guide to Hydrological Practices (WMONo. 168), Volume I, the Manual on Flood Forecasting and Warning (WMONo. 1072) and the Manual on Stream Gauging (WMONo. 1044), Volume I,.
3. Detailed guidance on observing practices for GAW observing systems and instruments is given in the [Guide to Instruments and Methods of Observation](#) (WMONo. 8) and related measurements guidelines published as GAW Reports.

2.4.1.6 Members should address the requirements for uncertainty, timeliness, temporal resolution, spatial resolution and coverage that result from the RRR process specified in section 2.2.4, and in accordance with the details provided in other sections as appropriate.

2.4.1.7 Members shall ensure that proper safety procedures are specified, documented and followed in all their operations.

Note: Safety practices and procedures are intended to ensure the welfare of staff while promoting overall efficiency and effectiveness of the NMHS. Such practices and procedures conform to national laws, regulations and requirements for occupational health and safety.

2.4.2 Observing practices

Members should ensure that their observing practices comply with user observational requirements.

Note: Observing practices include station operation, data processing practices and procedures, applied calculation rules, documentation on calibration practices and associated metadata.

2.4.3 Quality control

2.4.3.1 Members shall ensure that observations provided through their WIGOS component observing systems are quality controlled.

2.4.3.2 Members shall implement realtime quality control prior to exchange of observations via the WMO Information System.

Notes:

1. Quality control of observations consists in the examination of observations at stations and data centres to detect errors so that they may be either corrected or flagged. A quality control system should include procedures for tracing the observations to their source to verify them and to prevent the recurrence of errors. Quality control is applied in real time, but it also operates in nonreal time, as delayed quality control. The quality of observations depends on the quality control procedures applied during acquisition and processing of observations and during the preparation of messages, in order to eliminate the main sources of errors and ensure the highest possible standard of accuracy for the optimum use of those observations by all possible users.
2. Quality control in real time also takes place in the WMO Integrated Processing and Prediction System, prior to the use of meteorological and climatological observations in data processing (i.e. objective analysis and forecasting).
3. The Guide to the WMO Integrated Processing and Prediction System (WMO No. 305) provides more detailed guidance.
4. The Guide to the Global Observing System (WMO No. 488), Part VI, and the Guide to Instruments and Methods of Observation (WMO No. 8), Volume III, Chapter 1, 1.5, and Volume V, Chapter 1, 1.7, provide guidance on quality control of surface observations.
5. Recommended practices and procedures for quality control of aircraftbased observations and specifications for quality control of onboard data can be found in the Guide to Aircraftbased Observations (WMO No. 1200), Appendices A and B, and in the AMDAR Onboard Software Functional Requirements Specification (Instruments and Observing Methods, Report No. 115), Chapter 3.
6. Recommended practices and procedures for quality control of hydrological observations are given in the Manual on Flood Forecasting and Warning (WMO No. 1072), Chapter 6, and in the Guide to Hydrological Practices (WMO No. 168), Volume I.
7. Recommended practices and procedures regarding the quality of observations for GAW ~~requirements~~ applications are formulated in measurement guidelines through data quality objectives available under GAW Programme Reports ~~at <https://community.wmo.int/gawreports>~~ available in the WMO e-Library.
<https://community.wmo.int/gawreports>.

2.4.3.3 Members not capable of implementing these standards should establish agreements with an appropriate Regional Meteorological Centre or World Meteorological Centre to perform the necessary quality control.

2.4.3.4 Members shall also perform quality control of observations on a non-real-time basis, prior to forwarding the observations for archiving.

2.4.3.5 Members should develop and implement adequate quality control processes.

Notes:

1. Quality control processes include (but are not necessarily limited to): (a) validation; (b) cleaning and (c) monitoring.
2. Further guidance is available in the Guide to Instruments and Methods of Observation (WMO No. 8), the Guide to Climatological Practices (WMO No. 100), the Guide to Hydrological Practices (WMO No. 168), Volume I, and the Guide to the Global Observing System (WMO No. 488), Part VI.

2.4.4 Data and metadata reporting

Note: Members are to report and make available up-to-date WIGOS metadata as specified in section 2.5.2.

2.4.4.1 Members shall report and make available observations in real time through the WMO Information System (WIS) in the standard formats specified by the *Manual on Codes* (WMO ~~No. 306~~, Volumes ~~I.1~~, ~~No. 306~~), I.2 and I.3.

Note: This provision also applies to associated metadata provided in real time when it is part of the standard format.

2.4.4.2 Members shall use the International System of Units.

Notes:

1. Further information is available at www.bipm.org/en/measurementunits/.
2. Detailed guidance is given in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapter 1, 1.5.

2.4.4.3 When observing and reporting atmospheric pressure for meteorological purposes, Members shall use the hectopascal (hPa).

2.4.4.4 When observing and reporting air temperature for meteorological purposes, Members shall use the degree Celsius.

2.4.4.5 In the case of GAW observations, Members shall report and make observations available in standard formats as advised by World Data Centres, in accordance with the provisions laid out in Chapter 6.

2.4.4.6 Members shall record, retain and archive all observations they make available internationally.

Note: Nondestructive storage of observations is important to ensure that data and metadata quality and information content are not altered.

2.4.4.7 Members should record and retain all Level I data used when making observations available internationally.

2.4.5 Incident management

2.4.5.1 Members should implement incident management to detect, identify, record, analyse and respond to any incident, in order to restore normal operation of the observing system as quickly as possible, minimizing the negative impact and preventing recurrence.

2.4.5.2 Members shall implement procedures to detect, analyse and respond to system issues and human errors at the earliest stage possible.

Notes:

1. Some incidents, such as internal problems within the observing systems, may be detected automatically and reported without delay to international recipients of observations. Other incidents may be detected with delay or through periodic checks and reported accordingly.
2. Automatic incident detection can be performed using either built-in test equipment or external monitoring systems.

3. A centralized system can help monitor the performance and health of automatic weather station (AWS) systems and networks.

2.4.5.3 Members should record and analyse incidents as appropriate.

2.4.5.4 Members should provide incident information in accordance with 2.5 in real time.

Note: Such reporting in real time will be feasible when a corresponding WMO format is available.

2.4.5.5 Members should respond to incidents raised by the WIGOS Incident Management Function.

Notes:

1. The WIGOS Incident Management Function is to be operated by designated global centres and Regional WIGOS centres.
2. The WIGOS Data Quality Monitoring System (WDQMS) is described in Attachment 2.4.
3. Further guidance on WDQMS is provided by the Guide to the WMO Integrated Global Observing System (WMONo. 1165)

2.4.5.6 Members who exchange observations internationally should report any major incidents they detect to international recipients of observations, and should state when such incidents have been resolved.

2.4.6 Change management

2.4.6.1 Members should carefully plan and manage changes to ensure continuity and consistency of observations, and should record any modification related to the observing system.

Notes:

1. This requirement relates to any change in the observing system, including an observing station, observing programme, instruments, methods of observation and so on.
2. When changes are made, relevant metadata are to be updated in accordance with section 2.5.

2.4.6.2 When making changes to the observing system, Members should notify national and international stakeholders and observation users in advance.

Notes:

1. These notifications include information on the expected impacts and the time period over which the change will take place and, importantly, when the change is complete.
2. The record of changes includes the nature and characteristics of the change, the date and time of implementation and the reason for making the change.

2.4.6.3 In the event of significant changes in instruments or methods of observation used or the location in which observations are made, Members should ensure a sufficiently long period (to capture all expected climatic conditions) of overlap, with dual operation of old and new systems to identify biases, inconsistencies and inhomogeneities.

2.4.7 Maintenance

2.4.7.1 Members shall ensure that each observing system is rigorously maintained.

2.4.7.2 Members shall perform regular preventive maintenance of their observing systems including instruments.

Notes:

1. Carefully organized preventive maintenance of all system components is recommended to minimize corrective action and to increase the operational reliability of an observing system.

2. To minimize disruption to users, Members may provide advanced notice and discuss suitable timing.

2.4.7.3 Members shall determine the frequency and timing (schedule) of the preventive maintenance taking into account the type of observing system, environmental and climate conditions of the observing site and platform, and the instrumentation installed.

2.4.7.4 Members shall perform corrective maintenance in the event of failure of an observing system component as soon as practically possible once the issue has been detected.

Note: The assessment of what is practically possible may take into account the severity of the issue.

2.4.7.5 Members shall employ adaptive maintenance that satisfies the requirements for stability, continuity and consistency of observations through time.

2.4.7.6 Members should consider any maintenance activity that reduces data availability and quality as an incident.

2.4.7.7 Members should flag, remove or not report, as appropriate, observations that are adversely affected by maintenance activities.

Note: Detailed guidance on maintenance of observing systems and instruments is given in the Guide to Instruments and Methods of Observation (WMO No. 8), including technical papers on GAW measurements referenced in Volume I, Chapter 16; the Guide to Hydrological Practices (WMO No. 168), Volume I, and the Manual on Stream Gauging (WMO No. 1044), Volume I.

2.4.8 Inspection

Members shall arrange periodic inspections of their observing systems with the frequency and timing (schedule) adequate for the type of observing system, environmental and climate conditions of the observing site and platform, and the instrumentation installed.

Notes:

1. Such inspections could be undertaken on site or remotely, as necessary, to monitor the correct functioning of observing platforms and instruments.
2. Further guidance is available in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapter 1, 1.3.5; Volume III, Chapter 1, 1.7; and Volume V, Chapter 1, 1.10.1, and Chapter 4, 4.3.4; the Guide to Climatological Practices (WMO No. 100), 2.3.5 and 2.6.6; the Guide to Hydrological Practices (WMO No. 168), Volume I, 9.8.4; and the Guide to the Global Observing System (WMO No. 488), 3.1.3.8.

2.4.9 Calibration procedures

2.4.9.1 Members shall ensure that measurement systems and instruments are calibrated regularly in accordance with adequate procedures for each type of system and instrument, as described in the relevant sections of the present Manual.

Notes:

1. Where international or national standards are not available, the basis for calibration is defined or supplied by the manufacturer or by the scientific advisory groups for GAW observations.
2. Detailed guidance on calibration procedures is given in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume V, Chapter 4, the Guide to Hydrological Practices (WMO No. 168), Volume I, and the Manual on Stream Gauging (WMO No. 1044), Volume I.
3. In the GAW Programme, World Calibration Centres perform the audit of the stations and organize networkwide comparison campaigns, and require that every laboratory is traceable to the single network standard.

2.4.9.2 Members shall ensure that the measuring devices they use are:

- (a) **Calibrated or verified at specified intervals, or prior to use, against measurement standards traceable to international or national standards. Where no such standards exist, the method used for calibration or verification is to be recorded;**
- (b) **Adjusted or readjusted as necessary, but at the same time safeguarded from adjustments that would invalidate the measurements;**
- (c) **Identified, enabling the calibration status to be determined;**
- (d) **Protected from damage and deterioration during handling, maintenance and storage.**

Note: Details regarding hydrological observations are given in the Technical Regulations (WMONo. 49), Volume III; guidance is available in the Guide to Instruments and Methods of Observation (WMONo. 8), the Guide to Hydrological Practices (WMONo. 168), Volume I, and the Manual on Stream Gauging (WMONo. 1044), Volume I.

2.4.9.3 When the equipment is found not to conform to requirements, the Member shall assess and record the validity of previous measuring results and take appropriate action on the equipment and the products affected.

2.4.9.4 Members shall record and maintain the results of calibration and verification.

2.4.9.5 Members should consider any calibration or verification activity that reduces data availability and quality as an incident.

2.4.9.6 Members should flag, remove or not report, as appropriate, observations that are adversely affected by calibration or verification activity.

2.5 OBSERVATIONAL METADATA

2.5.1 Purpose and scope

Notes:

1. Observational metadata are essential as they enable users to assess the suitability of observations for the intended application, and managers of observing systems to monitor and control their systems and networks. Members benefit from sharing observational metadata which describe the quality of observations and provide information about stations and networks used to collect such observations.
2. Discovery metadata, defined in the Manual on the WMO Information System (WMONo. 1060), are concerned with discovering and accessing information, including observations and their observational metadata. Requirements for discovery metadata are specified in the *Manual on the WMO Information System* and are not considered further here.

2.5.1.1 For all WIGOS observations they make available internationally, Members shall record and retain the observational metadata specified as mandatory in Appendix 2.4 and in the WIGOS Metadata Standard (WMO-No. 1192).

Notes:

1. The WIGOS Metadata Standard (WMONo. 1192) defines a common set of requirements for observational metadata. It includes a detailed list of mandatory, conditional and optional metadata.
2. "Not available", "unknown" or "not applicable" are valid values for many elements of the WIGOS Metadata Standard. These terms assist Members in achieving compliance with the standard, particularly while developing the capability to report actual values.

2.5.1.2 For all WIGOS observations they make available internationally, Members shall record and retain the observational metadata specified as conditional in Appendix 2.4 and in the WIGOS Metadata Standard (WMO-No. 1192) whenever the related condition is met.

2.5.1.3 For all WIGOS observations they make available internationally, Members should record and retain the observational metadata specified as optional in Appendix 2.4 and in the WIGOS Metadata Standard (WMO-No. 1192).

2.5.1.4 For all WIGOS observations they make available internationally, Members should consider recording and retaining observational metadata that is additional to that specified in the *WIGOS Metadata Standard* (WMO-No. 1192).

Notes:

1. Such additional metadata are to be considered if they help users to interpret the observations or if they help operators to manage observing systems.
2. Some observational metadata do not change or change very infrequently compared to the observing cycle of the station/platform to which they relate. Such metadata, sometimes referred to as static metadata, can generally be made available through the database of the Observing Systems Capability Analysis and Review (OSCAR) tool, which is described in Attachment 2.3, but they must be monitored and updated in the OSCAR database when they change. Some observational metadata change with each new observation or quite often compared to the observing cycle. Such metadata, sometimes referred to as dynamic metadata, need to be made available as a standalone dataset or with the associated observations if an appropriate reporting format is available.
3. Some further requirements for observational metadata beyond the WIGOS Metadata Standard are stated in the following sections.
4. Further guidance on metadata and sound metadata practices is provided in the Guide to the WMO Integrated Global Observing System (WMO No. 1165) and other Guides and specific documentation associated with the individual observing system components.

2.5.2 Exchanging and archiving observational metadata

2.5.2.1 Members shall make available internationally, without restriction, those mandatory and conditional (whenever the condition is met) observational metadata that support the observations made available internationally.

2.5.2.2 Members making observations available internationally shall retain and make available, without restriction, observational metadata for at least as long as they retain the observations described by the observational metadata.

2.5.2.3 Members making available internationally archived observations shall ensure that all WIGOS metadata describing the observations remain available, without restriction, for at least as long as the observations are retained.

2.5.2.4 Members making available internationally archived observations should ensure that any additional observational metadata describing the observations remain available, without restriction, for at least as long as the observations are retained.

2.5.3 Global compilation of observational metadata

2.5.3.1 Members shall make available to WMO for global compilation those components of the WIGOS metadata that are specified as mandatory or conditional (whenever the condition is met).

Note: Global compilations of WIGOS metadata are held in several databases. The OSCAR database of the WIGOS Information Resource (WIR) is the key source of information for WIGOS metadata, including the metadata on atmospheric composition observations that are registered in the GAW Station Information System (GAWSIS). Other global compilations of specific components of WIGOS metadata include elements of the GAW Station Information System (GAWSIS), the OceanOPS database and others. Purpose and management of WIR and OSCAR are described in Attachment 2.3.

2.5.3.2 For all WIGOS component observing systems they operate, Members shall provide the required WIGOS metadata to keep the relevant databases of WMO observational metadata up to date.

2.5.3.3 Members shall routinely monitor the content of databases of WIGOS metadata and shall make all necessary changes in order to keep the databases up-to-date and accurate.

Note: Particular attention must be paid to critical elements of the WIGOS Metadata Standard, such as the geospatial location of Member observing stations/platforms. Members may wish to consult with the WMO Secretariat when undertaking these activities.

2.5.3.4 Members shall designate their national focal points responsible for making available metadata and for monitoring the content of databases of WMO observational metadata, and shall inform the Secretariat accordingly.

2.5.3.5 Members delegating to a global or regional entity the responsibility of the national focal point for all or part of the observing networks they operate shall inform the Secretariat accordingly.

2.6 QUALITY MANAGEMENT

Notes:

1. Detailed guidance on how to develop and implement a quality management system (QMS) to ensure and enhance the quality of products and services of NMHSs is provided in the Guide to the Implementation of Quality Management Systems for National Meteorological and Hydrological Services and Other Relevant Service Providers (WMONo. 1100).
2. The definitions, terminology, vocabulary and abbreviations used in relation to quality management are those of the International Organization for Standardization (ISO) 9000 family of standards for quality management systems, in particular *ISO 9000:2015, Quality Management Systems – Fundamentals and vocabulary*.
3. A QMS can be implemented only by the body that has the resources and the mandate to manage the observing system. According to the WMO QMF, Members are urged to follow the standard and recommended practices and procedures associated with the implementation of a QMS. In practice, however, it is one or more organizations within the Member country that own and operate observing systems and provide observations and observational metadata, most notably the NMHSs. Therefore, implementation of the WMO QMF relies on the Member making arrangements for such organizations to implement a QMS.
4. In this section, the term "observations" includes also observational metadata.

2.6.1 Scope and purpose of WIGOS quality management

Note: The practices and procedures of WIGOS enable Members to comply with the WMO QMF in relation to the quality of observations.

2.6.2 WIGOS component of the WMO Quality Management Framework

2.6.2.1 Quality policy

2.6.2.1.1 In the establishment and maintenance of WIGOS component observing systems, Members should ensure optimum affordable quality for all observations.

2.6.2.1.2 Members should, through a process of continual improvement, pursue effective and efficient management and governance of observing systems.

2.6.2.2 Application of the eight principles of quality management

Members should apply the eight principles of quality management to the implementation of WIGOS, as specified in Appendix 2.5.

2.6.3 WIGOS quality management processes

Note: The processes and roles of various entities are described in Attachment 1.1.

2.6.3.1 *Determination and maintenance of user requirements*

Note: The WMO RRR process for compiling user observational requirements is described in section 2.2.4 and Appendix 2.3.

2.6.3.2 *Development and documentation of observing system standards and recommendations*

Through involvement in the work of technical commissions, Members should participate in the development of observing system standard and recommended practices and procedures.

2.6.3.3 *Training of personnel and capacity development*

Members should ensure appropriate planning and implementation of training and capacity development activities.

2.6.3.4 *Performance monitoring*

2.6.3.4.1 Members should use and respond to the results, advice and reports of designated monitoring centres and any subsequent advice of expert groups.

2.6.3.4.2 Members should use and respond to the outputs from WIGOS Quality Monitoring and Evaluation Functions.

Notes:

1. The WIGOS Quality Monitoring and Evaluation Functions are to be carried out by designated global and Regional WIGOS Centres.
2. Existing lead and monitoring centres can be recognized as having a WIGOS Quality Monitoring and/or Evaluation Function, hence they can identify issues for the attention of Members.
3. Further guidance on WDQMS is provided by the Guide to the WMO Integrated Global Observing System (WMONo. 1165).

2.6.3.5 *Feedback, change management and improvement*

2.6.3.5.1 Members should ensure that issues and incidents identified by the WIGOS Data Quality Monitoring System Functions are rectified in a timely manner and that a process for their documentation and rectification is implemented and maintained.

Note: Existing lead and monitoring centres can be recognized as having a WIGOS Quality Monitoring and/or Evaluation Function, hence they can identify issues for the attention of Members.

2.6.3.5.2 Upon identification or notification of issues and incidents related to the quality of observations, Members should analyse the issue detected and make the necessary improvements to operational practices and procedures so as to minimize the adverse impacts of those issues and incidents and prevent their recurrence.

2.6.3.5.3 Members should ensure that changes to operational practices and procedures are documented accordingly.

2.6.4 *WIGOS aspects of development and implementation of the quality management system of Members*

Note: This section specifies requirements for the integration of WIGOS practices and procedures into the QMS of Members. The requirements are based on the eight clauses of the ISO 9001 standard. The Guide to the Implementation of Quality Management Systems for National Meteorological and Hydrological Services and Other Relevant Service Providers (WMONo. 1100) provides extensive explanatory notes about the eight clauses. The five subsections that follow correspond to the last five of those clauses, providing further details about the elements required in a QMS.

2.6.4.1 General requirements for the content of a quality management system

Members should identify their high-level processes and interactions that lead to the provision of observations.

Note: In addition to WIGOS specific provisions, there are many other general requirements for the content of a QMS that are not unique to WIGOS observations, hence they are not repeated here.

2.6.4.2 Requirements related to management and planning

2.6.4.2.1 Members should clearly demonstrate and document their commitment to the integration of WIGOS quality management practices within their QMS.

2.6.4.2.2 Members should carefully identify and routinely review user requirements for observations prior to attempting to meet user needs.

2.6.4.2.3 Members should ensure that their published quality policy is consistent with the WIGOS quality policy.

2.6.4.2.4 Members should establish and indicate the objectives for the observations they intend to provide in the future in order to guide stakeholders, users and clients with regard to the expected evolution of and changes to the observing systems they operate as a contribution to WIGOS.

Note: The objectives referred to in this provision constitute the WIGOS quality objectives.

2.6.4.2.5 Members should appoint a quality manager.

2.6.4.3 Requirements related to resource management

2.6.4.3.1 Members should determine and provide the resources needed to maintain and continuously improve the effectiveness and efficiency of their processes and procedures.

2.6.4.3.2 Members should define the competencies required of staff involved in the provision of observations.

2.6.4.3.3 Members should take steps to rectify any competency shortcomings identified for new or existing employees.

2.6.4.3.4 Members should implement policies and procedures to maintain the infrastructure required for the provision of observations.

2.6.4.4 Requirements related to the provision of observations

2.6.4.4.1 Members should undertake sound planning for the provision of observations.

Note: Such planning includes the following:

- (a) Determination and continuous review of user and client requirements;
- (b) Translation of user and client requirements into objectives and targets for observations and observing system design;
- (c) Initial and ongoing allocation of adequate resources for all aspects of the design, implementation and maintenance processes of observing systems;
- (d) Implementation of design processes and activities, including communication strategies and risk management, that will ensure the development and implementation of observing systems capable of meeting the design objectives and user and client requirements;
- (e) Appropriate and ongoing documentation of planning processes and their results.

2.6.4.4.2 Members should identify the users of their observing systems and establish and document user requirements for observations.

Note: This involves:

- (a) The WMO RRR process, described in section 2.2.4 and Appendix 2.3;
- (b) Other processes to establish user requirements within WMO Programmes through the activities of WMO technical commissions;
- (c) Regional processes through the activities of WMO regional associations and other multilateral groupings of Members;
- (d) National processes.

2.6.4.4.3 Members should have a clear description of the requirements that have been agreed upon.

Note: It is important to note the difference between aspirational requirements and agreed requirements. The establishment of requirements provides essential information for the monitoring and measurement of conformance.

2.6.4.4.4 Members should identify and adhere to any statutory or regulatory requirements in relation to the provision of observations.

2.6.4.4.5 Members should design and develop, or otherwise implement, observing systems to satisfy the agreed user requirements.

2.6.4.4.6 Members should use a formal change management process to ensure that all changes are assessed, approved, implemented and reviewed in a controlled manner.

2.6.4.4.7 Members should conduct purchasing in a controlled manner.

Note: Observing systems are highly specialized and often require major expenditure. Staff responsible for purchasing orders or for providing information to suppliers must, therefore, ensure that the information and specifications provided are clear, unambiguous and based on the design objectives and system requirements to enable the delivery of the appropriate products and services. Purchasing in a controlled manner entails the following:

- (a) Written specification of all performance requirements for equipment and/or services;
- (b) Ensuring that purchasing is subject to a competitive process of more than one candidate for supply of equipment or services;
- (c) Assessment of candidates for supply of equipment or services based on merit and suitability for purpose, which can be discerned from:
 - (i) Written tendering or quotation of candidates;
 - (ii) Experience or reliable anecdotal evidence of past performance;
 - (iii) Recommendation of a Member or a recognized organization or agency;
- (d) Documentation of the purchasing process and outcomes.

2.6.4.4.8 Members should include in their QMS the WIGOS provisions covering methods of observation, calibration and traceability, operational practices, maintenance and observational metadata.

2.6.4.4.9 Members should implement practices and procedures ensuring that observations remain accurate.

Notes:

1. Observations need to be checked as they must meet the agreed requirements. The methods used include automated algorithms, manual inspection and oversight.

2. Outputs available from WIGOS quality monitoring, evaluation and incident management functions are also to be integrated into such practices and procedures.

2.6.4.5 Requirements for monitoring, performance measurement, analysis and improvement

2.6.4.5.1 Members should use the agreed user requirements for observations (see 2.6.4.4) as a basis for defining and implementing appropriate measures of performance and success.

Notes:

1. It is important to gain a clear understanding of how satisfied users are with observations. This requires the monitoring of information on users' perception and on whether their expectations have been met. Surveys are commonly used for this purpose.
2. The WDQMS monitoring and evaluation thresholds, which trigger issues and incidents to be raised with Members through the incident management function, are based on agreed-upon user requirements.

2.6.4.5.2 Members should implement activities to obtain information on the satisfaction of users of observations.

2.6.4.5.3 Members should ensure that staff are made aware of the methods employed for determining users' perceptions and expectations, and that those methods are applied consistently.

2.6.4.5.4 Members should regularly conduct internal audits of WIGOS processes and procedures, and analyse the results as part of the management processes of the observing system.

Note: A detailed explanation of the requirements of the internal audit is provided in the Guide to the Implementation of Quality Management Systems for National Meteorological and Hydrological Services and Other Relevant Service Providers (WMONo. 1100), Chapter 4, section 4.5, clause 9, requirement 9.2.

2.6.4.5.5 Members should monitor the degree of adherence to the defined processes and requirements for producing observations.

Note: Ideally, performance monitoring will be conducted against specific key performance indicators and target levels of performance.

2.6.4.5.6 Members should monitor and measure the suitability and the quality of their observations as they are produced, in order to compare their characteristics with the agreed requirements.

Note: This involves:

- (a) The devising, implementation and routine analysis of manually or automatically generated key performance indicators and their associated targets;
- (b) Manual inspection and oversight of the observational data produced.

2.6.4.5.7 Members should use the outputs from the WIGOS Quality Monitoring, Evaluation and Incident Management Functions for monitoring and confirming the suitability and quality of their observations.

2.6.4.5.8 Members should record instances of non-conformance with requirements, and endeavour to rectify issues and incidents in a timely manner.

Note: The Incident Management Function of the WDQMS can assist Members in identifying instances of nonconformance with requirements.

2.6.4.5.9 Members should maintain a documented corrective action procedure relevant to observations.

2.6.4.5.10 Members should specify and implement procedures that describe how non-conforming observations or observational metadata are identified, how they are dealt with, who is responsible for deciding what to do, what action should be taken and what records are to be kept.

Note: A detailed explanation of the requirements for corrective action is provided in the Guide to the Implementation of Quality Management Systems for National Meteorological and Hydrological Services and Other Relevant Service Providers (WMO No. 1100), Chapter 4, section 4.5, clause 10, requirements 10.2.

2.6.4.5.11 Members should analyse monitoring results to detect any performance-related changes, trends and deficiencies and should use the results and analyses as input for continual improvement.

Notes:

1. Analysing trends and taking action prior to the occurrence of a case of nonconformance helps to prevent problems.
2. Careful analysis of trends is essential to differentiate between equipment drift and a physical change of the physical parameter.

2.6.4.5.12 Members should use the outputs from the WIGOS Quality Monitoring, Evaluation and Incident Management Functions as input for continual improvement.

2.6.4.5.13 Members should maintain documented preventive action procedures relevant to observing systems, and should ensure that staff are aware of and, if necessary, trained in their routine application.

Note: Due consideration might be given to combining the preventive and the corrective procedures for efficiency, and to simplify the process.

2.6.5 Compliance, certification and accreditation

Note: While WMO encourages the certification of Members' quality management systems by accredited agencies, unless otherwise required of a particular WIGOS component system or subsystem, there is no general regulated requirement for certification of QMS for WIGOS component observing systems.

2.6.6 Documentation

2.6.6.1 Members should include the WIGOS quality policy (2.6.2.1) and objectives (2.6.4.2) in their QMS quality manual.

2.6.6.2 Members should include in their QMS documentation those documents that describe the procedures related to WIGOS, including, in particular, those relating to control of non-conforming observations, and corrective and preventive actions.

2.6.6.3 Members should include in their QMS documentation those documents that describe the procedures required to ensure the effective planning, operation and control of their WIGOS processes.

2.6.6.4 Members should include in their QMS documentation those records required by the ISO 9001 standard.

Note: More detailed information on documentation requirements is provided in the Guide to the Implementation of Quality Management Systems for National Meteorological and Hydrological Services and Other Relevant Service Providers (WMO No. 1100), Chapter 4, section 4.5, clause 4, requirement 4.4.

2.7 CAPACITY DEVELOPMENT

2.7.1 General

2.7.1.1 Members should identify their needs for capacity development in all activity areas of WIGOS.

2.7.1.2 Members should develop plans to meet their capacity development needs.

Note: In addition to national resources allocated to NMHSs, support may be available from other domestic agencies, the WMO regional association concerned, other Members through bilateral or multilateral arrangements, and WMO Programmes (including appropriate technical commissions).

2.7.1.3 Members should establish bilateral and multilateral collaboration (within and beyond their region) where necessary to address capacity development needs.

2.7.1.4 When planning capacity development activities, Members should take a holistic approach considering institutional, infrastructural, procedural and human resource requirements to support both current and continuing needs for installation, operation, maintenance, inspection and training. For this purpose, Members should prepare specific capacity development plans with measurable objectives to enable effective implementation, monitoring and assessment.

Note: Funds to meet these requirements should be planned well ahead, subject to national policies of Members, to assure longterm sustainable networks.

2.7.2 Training

2.7.2.1 Members shall provide adequate training for their staff or take other appropriate action to ensure that all staff are suitably qualified and competent for the work assigned to them.

Note: This requirement applies both to initial recruitment or introductory training and to continuing professional development.

2.7.2.2 Members should ensure that the qualifications, competencies, skills (and thus, training) and numbers of their personnel or other contractors match the range of tasks to be performed.

2.7.2.3 Members should inform the staff of their role and how they contribute to the achievement of the quality objectives.

2.7.3 Infrastructural capacity development

Members should regularly review their infrastructure for collecting and making available observations and observational metadata and should develop, as necessary, prioritized plans and priorities for capacity development.

APPENDIX 2.1. OBSERVING NETWORK DESIGN PRINCIPLES

1. SERVING MANY APPLICATION AREAS

Observing networks should be designed to meet the requirements of multiple application areas within WMO and WMO co-sponsored programmes.

2. RESPONDING TO USER REQUIREMENTS

Observing networks should be designed to address stated user requirements, in terms of the geophysical variables to be observed in the relevant domains (vertical layer/s and horizontal coverage), the space-time resolution, uncertainty, and timeliness and stability needed, while taking into account relative priorities.

3. MEETING NATIONAL, REGIONAL AND GLOBAL REQUIREMENTS

Observing networks designed to meet national needs should also take into account the needs of WMO at the regional and global levels.

4. DESIGNING APPROPRIATELY SPACED NETWORKS

Where high-level user requirements imply a need for spatial and temporal uniformity of observations, network design should also take account of other user requirements, such as the representativeness and usefulness of the observations.

5. Designing cost-effective networks

Observing networks should be designed to make the most cost-effective use of available resources. This will include the use of composite observing networks.

6. ACHIEVING HOMOGENEITY IN OBSERVATIONAL DATA

Observing networks should be designed so that the level of homogeneity of the delivered observational data meets the needs of the intended applications.

7. DESIGNING THROUGH A TIERED APPROACH

Observing network design should use a tiered structure, through which information from reference observations of high quality can be transferred to other observations and used to improve their quality and utility.

8. DESIGNING RELIABLE AND STABLE NETWORKS

Observing networks should be designed to be reliable and stable.

9. MAKING OBSERVATIONAL DATA AVAILABLE

Observing networks should be designed and should evolve in such a way as to ensure that the observations are made available to other WMO Members, at space-time resolutions and with a timeliness that meet the needs of regional and global applications.

10. PROVIDING INFORMATION SO THAT THE OBSERVATIONS CAN BE INTERPRETED

Observing networks should be designed and operated in such a way that the details and history of instruments, their environments and operating conditions, their data processing procedures and other factors pertinent to the understanding and interpretation of the observational data (i.e. metadata) are documented and treated with the same care as the data themselves.

11. ACHIEVING SUSTAINABLE NETWORKS

Improvements in the sustained availability of observations should be promoted through the design and funding of networks that are sustainable in the long term including, where appropriate, through the transition of research systems to operational status.

12. MANAGING CHANGE

The design of new observing networks and changes to existing networks should ensure adequate consistency, quality and continuity of observations during the transition from the old system to the new.

13. ADVANCING ENVIRONMENTAL SUSTAINABILITY

The environmental impacts of observing networks should be considered in their design and operation. Advancements in the environmental sustainability of networks should be promoted where viable solutions are available that meet user requirements.

APPENDIX 2.2. CLIMATE MONITORING PRINCIPLES OF THE GLOBAL CLIMATE OBSERVING SYSTEM

~~2.2.1 Effective monitoring systems for climate should adhere to the following principles:~~

- ~~(a) The impact of new systems or changes to existing ones should be assessed prior to implementation;~~
- ~~(b) A suitable period of overlap between new and old management of observing systems is required. This would be a period of dual operation, under the same climatic conditions, of the current for climate-related needs across all domains (surface, above surface, and new subsurface), all observing systems, to identify platforms, and record any impact of the change;~~
- ~~(c) The details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to interpreting data (i.e. metadata) should be documented and treated with the same care as the data themselves;~~
- ~~(d) The quality and homogeneity of data should be regularly assessed as part of routine operations;~~
- ~~(e) Consideration of the need for environmental and all essential climate monitoring products and variables (ECVs). They address the needs for generating datasets for monitoring the climate system and its changes, for supporting climate applications, for underpinning assessments, such as the Intergovernmental Panel on Climate Change (IPCC), and for informing action by Parties to the UNFCCC. Therefore, these GCOS Climate Change (IPCC) assessments, Monitoring Principles should be integrated into national, regional, and global observing priorities;~~
- ~~(f) The operation of historically uninterrupted stations and plans, in response to GCOS Implementation Plans and GCOS Status Reports and aiming at a consistent global observing systems should be maintained; system for climate through an internationally coordinated effort.~~
- ~~(g) Data Several of these principles are also related to the observing network design principles specified in the WIGOS Manual (WMO-1160). Consistent with the WIGOS Manual, principles are expressed using "should" rather than "shall". However, failure to abide by these principles is likely to significantly limit the utility of the collected observations for climate-relevant purposes.~~

Principles:

1. **Spatial and Temporal Sampling:** It is critical for observations to sample the Earth system in such a way that climate-relevant diurnal, seasonal, interannual and long-

term changes can be resolved. When the opportunity exists to fill gaps in the existing observing system high priority should be given to data-poor regions, poorly observed parameters, regions sensitive to change, and key measurements with inadequate temporal resolution ~~should be high-priority areas for additional observations;~~

- (h) ~~Longterm requirements, including~~ **System Design:** Observing systems should encompass both in-situ and remote sensing platforms as appropriate based on their respective strengths and limitations. Climate monitoring requirements regarding appropriate spatial and temporal sampling ~~frequencies,~~ instrument precision and accuracy, and stability should be specified to ~~network~~ observing system designers, operators, and instrument engineers at the outset of system design and implementation;
2. ~~(i) A carefully planned conversion.~~ Observing systems should include reference observations to ensure well characterized measurement time series traceable to SI and/or community standards with robustly quantified uncertainties that can be used with confidence. Periodic reviews should be conducted to assess the feasibility and benefits of ~~research~~ incorporating new technologies into the observing systems ~~to long-term operations should be promoted;~~
 3. ~~(j) System Sustainability:~~ For in-situ observations, operation of historically uninterrupted stations and observing systems that meet the specified calibration, stability, and siting requirements should be maintained for as long as possible. For satellite measurements, continuity should be ensured through appropriate launch and orbital strategies. Relevant climate research^[1] observing systems and networks should be sustained and transitioned to operational status.
 4. **System Change Management:** The impact of new systems or changes to existing systems should be assessed prior to implementation. A suitable period of overlap between new and old instruments and observing systems should be ensured for a period adequate to determine inter-instrument biases and maintain the homogeneity and consistency of time-series observations.
 5. **Metadata:** In order to ensure the utility of the observations, the details and history of local conditions, site location, instruments, operating procedures, data processing algorithms, data errors and biases, and other factors pertinent to interpreting data (i.e., metadata) and their changes over time should be documented and treated with the same care as the data themselves.
 6. **Calibration:** Prior to the deployment of a new instrument or observing platform, its technical characteristics, such as accuracy, precision, and stability, should be rigorously documented and calibrated in order to ensure consistency with climate-relevant requirements. Calibration should be traceable to SI units or to reference observations. Following deployment, all system components should be regularly recalibrated or otherwise evaluated to ensure the highest data quality.
 7. **Data Quality and Homogeneity:** The quality and homogeneity of data should be regularly assessed as a part of routine operations. Random errors and biases in the observations should be identified and documented.
 8. **Data and Metadata Preservation:** Data and metadata should be preserved for secure, long-term storage and retrieval in an appropriate repository according to relevant international standards.
 9. **Data Access:** Data management systems that facilitate access ~~to, and the,~~ use, and interpretation of data and products should be included as essential elements of climate monitoring systems. ~~These systems should facilitate open user access to climate products, metadata, and raw data, including key data for delayed-mode analysis, in line with the WMO Unified Data Policy (Resolution 1).~~

~~Furthermore, operators of satellite systems monitoring the climate need to:~~

- ii. ~~Take steps to make radiance calibration, calibration monitoring and satellite to satellite crosscalibration of the full operational constellation a part of the operational satellite system;~~

- ~~ii. Take steps to sample the Earth system in such a way that climate-relevant (diurnal, seasonal, and long-term interannual) changes can be determined;~~

~~2.2.2 Satellite systems for climate monitoring should adhere to the following specific principles:~~

- ~~(a) Constant sampling within the diurnal cycle (minimizing the effects of orbital decay and orbit drift) should be maintained;~~
- ~~(b) A period of overlap for new and old satellite systems should be ensured that is long enough to determine intersatellite biases and maintain the homogeneity and consistency of time-series~~ **Data Exploitation:** ~~The collected observations;~~
- ~~(c) Continuity of satellite measurements (i.e. elimination of gaps in the long-term record) through appropriate launch and orbital strategies should be ensured;~~
- ~~(d) Rigorous pre-launch instrument characterization and calibration, including radiance confirmation against an international radiance scale provided by a national metrology institute, should be ensured;~~
- ~~(e) Onboard calibration adequate for climate system observations should be ensured and associated instrument characteristics should be monitored;~~
- ~~(f) The operational provision of priority climate products should be used to generate datasets of ECVs. In order to keep pace with evolving technologies, climate-relevant requirements, and methods, these datasets should be sustained, and peer-reviewed new products should be introduced regularly assessed, and reprocessed as appropriate;~~
- 10. ~~(g) Data systems needed to facilitate user access to climate products, metadata and raw data, including key data for delayed mode analysis, should be established and maintained;~~
- ~~(h) The use of functioning baseline instruments that meet the calibration and stability requirements stated above should be maintained for as long as possible, even when such instruments exist on decommissioned satellites;~~
- ~~(i) Complementary in-situ baseline observations for satellite measurements should be maintained through appropriate activities and cooperation between space agencies and owners of in-situ networks;~~
- ~~(j) Random errors and time-dependent biases in satellite observations and derived products should be identified;~~

^[1] ~~Research observing systems and networks are often short-term funded with no guarantee for long-term operations.~~

APPENDIX 2.3. THE WMO ROLLING REVIEW OF REQUIREMENTS

1. INTRODUCTION

WMO Members should endeavour to collect and share observations which address their collective requirements, by implementing and operating WIGOS component observing systems. The purpose of the Rolling Review of Requirements (RRR) process is to provide a systematic and transparent process to support the high-level design and evolution of WIGOS. Section 2.2.4 indicates that Members shall contribute to the RRR process.

The RRR process compiles information on Members' evolving requirements for observations in WMO application areas.

A WMO application area is an activity involving the direct use of observations that allows National Meteorological and Hydrological Services or other organizations to render services related to weather, climate, water and other environmental events, contributing to public safety, socioeconomic well-being and development in their respective territories. The concept of a WMO application area is used in the framework of the WMO RRR and describes a homogeneous activity for which it is possible to compile a consistent set of observational user requirements agreed by community experts working in that area.

The RRR also assesses: (a) the extent to which current and planned WIGOS component observing systems satisfy Member requirements for observations in WMO application areas; (b) guidance from experts in each application area on gaps and priorities, in order to tackle the deficiencies and opportunities in WMO observing systems; and (c) plans for the future evolution of WIGOS component observing systems.

Note: The most detailed and up-to-date description of the RRR process is available on the WMO website at <https://community.wmo.int/rollingreviewrequirementsprocess>.

An expert is identified for each application area to be the Point of Contact. This expert has a very important role as the conduit to the RRR for input to and feedback from the entire stakeholder community for that application area. Each application area is “owned” by an identified body which has the authority to designate the Point of Contact and oversee their work. Application areas are grouped in six Earth System Application Categories (ESACs), as shown in the table. The list of application areas under each category is evolving with WMO needs, and is maintained by the Commission for Observation, Infrastructure and Information Systems (INFCOM) in consultation with the Commission for Weather, Climate, Hydrological, Marine and Related Environmental Services and Applications (SERCOM).

Table. Earth System Application Categories and application areas

<i>Earth system application category</i>	<i>Application area</i>
1. Space weather applications	1.1 Sun, heliosphere and solar wind forecasting and monitoring
	1.2 Energetic particle and magnetosphere forecasting and monitoring
	1.3 Ionosphere, thermosphere and geomagnetic field forecasting and monitoring
2. Atmospheric applications	2.1 Global numerical weather prediction and real-time monitoring
	2.2 High-resolution numerical weather prediction
	2.3 Nowcasting/very short-range forecasting
	2.4 Sub-seasonal to longer predictions
	2.5 Atmospheric climate ~~forecasting and~~ monitoring
	2.6 Atmospheric composition forecasting and monitoring
	2.7 Atmospheric composition information services in urban and populated areas
	2.8 Aeronautical meteorology
	2.9 Agricultural meteorology
	~~2.10 Atmospheric disaster risk reduction~~
3. Oceanic applications	3.1 Ocean ~~mesoscale~~ forecasting and real-time monitoring
	3.2 Coastal forecasting
	3.3 Oceanic climate monitoring and services
	3.4 Tsunami monitoring and detection
	3.5 Marine environmental emergency response
	3.6 Maritime safety (ports to open ocean)
	~~3.7 Ocean Biogeochemical Cycles Application Area~~
4. Hydrological and terrestrial applications	4.1 Hydrology forecasting and real-time monitoring
	4.2 Hydrological and terrestrial climate monitoring
	~~4.3 Hydrological and terrestrial disaster risk reduction~~
5. Cryospheric applications	5.1 Terrestrial cryosphere forecasting and monitoring
	5.2 Sea ice forecasting and monitoring
	5.3 Cryospheric climate monitoring
	~~5.4 Cryospheric disaster risk reduction~~
6. Integrated Earth system applications	6.1 Earth system forecasting and monitoring
	6.2 Understanding Earth system processes

Notes:

- Each application area considers its requirements for observations, not only for operational activities but also for the research that will enable its future activities and evolving usage of observations. Application area “6.2 Understanding Earth system processes” considers the requirements for observations of all WMO research activities not covered in any other application area.
- The list of application areas is intended to include all WMO uses of observations. It needs to be checked periodically for completeness and updated accordingly.

3. Application areas dealing with atmospheric composition and agricultural meteorology, numbered 2.6, 2.7 and 2.9, include some activities which may have an affinity with other ESACs. Each application area may consider whether it is to be split into components belonging to different ESACs, in the way that disaster risk reduction and climate monitoring are split into different ESACs.
4. Application area "5.1 Terrestrial cryosphere forecasting and monitoring" includes snow, glaciers and permafrost.
5. Application area 6.1 deals with the integrated Earth system, including all domain interfaces between components of the integrated Earth system.

The RRR process consists of five stages, as illustrated ~~in the~~ figure 2.1 and explained in the following sections:

1. Review of user requirements for observations;
2. Review of current and planned observing system capabilities;
3. Critical Review;
4. Statements of Guidance;
5. High-level Guidance for the Evolution of Global Observing Systems.

Figure 2.1. Elements of the RRR process

2. REVIEW OF USER REQUIREMENTS FOR OBSERVATIONS

Section 2.1 indicates that Members shall contribute to the compilation of user requirements by the RRR. Each Point of Contact consults widely with the community of experts in their application area, considers any relevant guidance from Observations Impact Studies (see 2.2.5), and applies their own expert assessment, in order to establish a consensus view of the requirements for observations. These user requirements are intended to be technology-free, that is, unconstrained by any particular type of observing technology or system.

The level of detail compiled will be sufficient to enable high-level analysis and guidance for WIGOS observing systems, but is not intended to capture all the lower-level fine details involved in designing an individual observing system.

Each requirement for an application area is expressed quantitatively as a specific physical variable to be observed, in a specific domain (vertical layer/s and horizontal coverage), with a performance level quantified in terms of up to eight criteria: uncertainty, horizontal resolution, vertical resolution, observing cycle, timeliness and stability, as well as the recently added criteria "layer/s quality" and "coverage quality", including "relative priority" for each of these criteria.

Requirement records are stored in, and accessible from, a component database of the Observing Systems Capability Analysis and Review tool known as OSCAR/Requirements. Further details are provided in Attachment 2.3, ~~Attachment 3.1~~ and online at <https://community.wmo.int/oscarwmoobservationalrequirementsandcapabilities>.

Points of Contact have access rights to OSCAR/Requirements to edit (update or add) proposed changes to the requirements of their application area.

Note: ~~Within the context of the Guide to Instruments and Methods of Observation (WMO-No. 8) and other related documentation, the term "uncertainty" is aligned to the International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM), Joint Committee for Guides in Metrology (JCGM) 200:2012, and the Evaluation of Measurement Data – Guide to the Expression of Uncertainty in Measurement, JCGM 100:2008 (hereinafter referred to as the GUM). These publications define "expanded uncertainty" as a quantity defining an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand, at a typical 95% confidence level. Within INFCOM, this is the definition used when referring generally to uncertainty, rather than the root-mean-square error (68% confidence level) quoted in OSCAR/Requirements. It is~~ quoted in the OSCAR/Requirement characterizes the estimated range of observation errors (Root-Mean-Square-Error - RMSE) on the given variable, with a 68% confidence interval (1 σ). Providers of observations should interpret the RRR uncertainty requirement as bias and random error, combined in the root-mean square sense. Within the context of the Guide to Instruments and Methods of Observation (WMO-No. 8) and other related documentation, the term

important to take this difference of meaning into account when comparing similar information between OSCAR and INFCOM. It is also noted that most reputable manufacturers of instruments also comply with the GUM, however this needs to be checked on a case-by-case basis.

3. REVIEW OF CURRENT AND PLANNED OBSERVING SYSTEM CAPABILITIES

Members shall take steps for collecting, reviewing, recording and making available information on current and planned capabilities of observing systems.

Note: Information on observing system capabilities is in the form of metadata and is to be made available for global compilation according to the provisions of section 2.5.

The Infrastructure Department of the WMO Secretariat coordinates the compilation of observing capabilities data in two databases: capabilities of the WIGOS space-based subsystem are stored in OSCAR/Space and capabilities of the WIGOS surface-based subsystem are stored in OSCAR/Surface. Additional information about WIGOS observing capabilities may be obtained from other sources such as the assessments provided by the monitoring and evaluation components of the WIGOS Data Quality Monitoring System (WDQMS). Further details are provided in Attachment 2.3, Attachment 2.4, and online at <https://space.oscar.wmo.int/>.

4. CRITICAL REVIEW

The Critical Review represents the first step in comparing WIGOS observing capabilities to the requirements in an objective fashion to identify gaps. Some effort is needed to investigate and understand the observing capabilities in an integrated way and to assess how well they address the requirements. Tools are available which provide a limited scope of comparisons: OSCAR/Space is supplemented with a gap analysis tool which assesses the capabilities of various satellite instruments against requirements; and the monitoring and evaluation components of the WDQMS provide ongoing assessments of how well actual surface observations meet the planned performance levels.

Each Point of Contact undertakes this effort in some form as an initial step in analysing the gaps and priorities for action relevant to their application area, before drafting their input to the Statement of Guidance.

5. STATEMENTS OF GUIDANCE

For each of the six Earth System Application Categories, a Statement of Guidance (SoG) is prepared under the co-authorship of the Points of Contact of all the application areas grouped in that Earth System Application Category. A Coordinator is selected from among them to be the lead author and to take responsibility for coordinating and completing the SoG.

The role of an SoG is to provide a synthesis and interpretation of the outputs of the critical reviews as gap analyses for the relevant application areas, to draw conclusions, and to identify priorities for action. The process of preparing such a statement is necessarily more subjective than that of the critical review, drawing on the judgement and experience of the contributing Points of Contact and the experts and other stakeholders they each consult within their respective application areas. Moreover, while a review attempts to provide a comprehensive summary, an SoG is more selective, drawing out key issues.

A template is available to support the current process for the development of SoGs, which differs from the previous process in which each Point of Contact used to separately prepares an SoG for each application area.

6. HIGH-LEVEL GUIDANCE FOR THE EVOLUTION OF GLOBAL OBSERVING SYSTEMS

The *High-level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WMO Integrated Global Observing System (WIGOS) in 2040* is produced by INFCOM by building on the other elements of the RRR process. It draws on the Statements of Guidance for all Earth System Application Categories and their component applications areas, considers overall cost-effectiveness, is guided by WMO priorities and responds to the Vision for the WMO Integrated Global Observing System in 2040 (WMO-No. 1243) (see 2.2.3). It is a key document that aims to provide Members with clear and focused guidelines and recommended actions for the next 4–5 years, in order to stimulate cost-effective evolution of the observing systems and to address in an integrated way the requirements of WMO programmes and co-sponsored programmes.

The title of the current version is *High-level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WMO Integrated Global Observing System (WIGOS) in 2040*, and may be accessed online at <https://community.wmo.int/en/rolling-review-requirements-process-2023-version>.

7. REGIONAL ASPECTS

Within each application area there may be some differences in how activities are conducted or prioritized from region to region, and there may therefore be some differences in the requirements for observations. Regional experts should liaise with the Points of Contact so that regional differences in requirements are recognized and documented in the OSCAR/Requirements database. Within the data structure used to represent requirements, there are several ways that a Point of Contact can achieve granularity and show different requirements in different regions.

In particular, regional experts involved in the Regional Basic Observing Network (RBON) design process (see 3.2.3) should collaborate with the Points of Contact of all relevant application areas to ensure that regional differences in requirements are documented in OSCAR/Requirements, and that regional gap analyses and plans/guidance for the evolution of observing systems are compatible with and complementary to those developed at the global level.

8. FURTHER CONSIDERATIONS

The outputs of the RRR process aim to influence the actions of observing system owners, operators, planners and sponsors in all Member States and Territories and other supportive entities as they evolve their observing systems for greater capabilities. It is also intended that the WIGOS-related technical regulations will further evolve in association with this.

The RRR should broadly cover all WMO applications, whether global, regional or national, which require international observations. It is important that any deficiencies in this respect are reported to INFCOM so that they can be considered and corrected. More generally, all stakeholders are invited to share feedback regarding any aspect of the RRR process.

APPENDIX 2.4. THE WIGOS METADATA STANDARD

1. GENERAL

This appendix refers to the WIGOS Metadata Standard, which consists of the set of observational metadata elements to be made available internationally, for the effective interpretation of observations from all WIGOS component observing systems by their users. In this way, metadata users can access important information about why, where and how an

observation was made. Metadata also provide information on the processing of the raw data and data quality. Note that WIGOS metadata, which are required from specific components or subsystems, are detailed in sections 3–8 of this Manual.

The table below presents categories (or groups) of metadata, each containing one or more elements. Each element is classified (using the same terminology as the International Organization for Standardization (ISO)) as mandatory (M), conditional (C) or optional (O). In the table, the mandatory elements are shown in bold and the conditional elements in italics.

A more detailed definition of each metadata element, together with notes and examples, and an explanation of the conditions that apply to the conditional elements are specified in the WIGOS Metadata Standard (WMO-No. 1192).

2. MEMBERS' OBLIGATIONS

Mandatory metadata elements shall always be made available. The content of the corresponding fields shall never be empty: either the metadata value or, in specified cases, the reason for no-value shall be made available.

Conditional metadata elements shall be made available when the specified condition or conditions are met, in which case the content of the corresponding fields shall never be empty: either the metadata value or the reason for no-value shall be made available.

Optional metadata elements should be made available, as they provide useful information that can help to better understand an observation. These elements are likely to be important for a particular community, but less so for others.

3. ADOPTION THROUGH A PHASED APPROACH

Making WIGOS metadata available generates substantial benefits for Members, but developing the capacity to make these metadata available requires a substantial effort on the part of (meta)data providers. To help Members comply with reporting obligations, guidance material is provided in the Guide to the WMO Integrated Global Observing System (WMO-No. 1165).

Moreover, a phased approach was adopted during the implementation period as shown in the table. All Members are now expected to be compliant with the Standard in its entirety, however the three phases may still be a helpful reference for those Members, or operators within Member countries, who are developing their capacity to comply.

Elements emerging as being important for specific application areas or observing programmes will be added to the standard as it evolves.

**List of elements specified in the WIGOS Metadata Standard,
and the historical phases of implementation**

Category	Phase I	Phase II	Phase III
	2016	2017–2018	2019–2020
1. Observed variable	1-01 Observed variable – measurand (M)	1-05 Representativeness (O)	
	<i>1-02 Measurement unit (C)</i>		
	1-03 Temporal extent (M)		

Category	Phase I	Phase II	Phase III
	2016	2017–2018	2019–2020
	1-04 Spatial extent (M)		
2. Purpose of observation	2-01 Application area(s) (O)		
	2-02 Programme/network affiliation (M)		
3. Station/platform	3-01 Region of origin of data (C)	3-04 Station/platform type (M) 3-08 Data communication method (O)	3-10 Station/platform cluster (O)
	3-02 Territory of origin of data (C)		
	3-03 Station/platform name (M)		
	3-06 Station/platform unique identifier (M)		
	3-07 Geospatial location (M)		
	3-09 Station operating status (M)		
4. Environment		4-04 Events at observing facility (O)	4-01 Surface cover (O)
		4-05 Site information (O)	4-02 Surface cover classification scheme (C)
			4-03 Topography or bathymetry (O)
			4-06 Surface roughness (O)
			4-07 Climate zone (O)
5. Instruments and methods of observation	5-01 Source of observation (M)	5-11 Maintenance party (O)	5-04 Instrument operating status (O)
	5-02 Measurement/observing method (M)	5-12 Geospatial location (C)	5-06 Configuration of instrumentation (C)
	5-03 Instrument specifications (O)	5-15 Exposure of instruments (C)	5-07 Instrument control schedule (O)
	5-05 Vertical distance of sensor (C)		5-08 Instrument control result (C)
			5-09 Instrument model and serial number (O)
			5-10 Instrument routine maintenance (O)
			5-13 Maintenance activity (O)
			5-14 Status of observation (O)
6. Sampling	6-03 Sampling strategy (O)	6-05 Spatial sampling resolution (O)	6-01 Sampling procedures (O)
	6-07 Diurnal base time (C)		6-02 Sample treatment (O)
	6-08 Schedule of observation (M)		6-04 Sampling time period (O)
			6-06 Temporal sampling interval (O)
7. Data processing and reporting	7-03 Temporal reporting period (M)	7-02 Processing/analysis centre (O)	7-01 Data-processing methods and algorithms (O)
	7-04 Spatial reporting interval (C)	7-06 Level of data (O)	7-05 Software/processor type and version (O)
	7-11 Reference datum (C)	7-09 Aggregation period (O)	7-07 Data format (O)
		7-10 Reference time (O)	7-08 Version of data format (O)

Category	Phase I	Phase II	Phase III
	2016	2017–2018	2019–2020
			7-12 Numerical resolution (O)
			7-13 Timeliness (of reporting) (O)
			7-14 Schedule of international exchange (M)
8. Data quality		8-01 Uncertainty of measurement (O)	
		8-02 Procedure used to estimate uncertainty (C)	
		8-03 Quality flag (O)	
		8-04 Quality flagging system (C)	
		8-05 Traceability (C)	
9. Ownership and data policy	9-02 Data policy/use constraints (M)	9-01 Supervising organization (M)	
10. Contact	10-01 Contact (nominated focal point) (M)		

APPENDIX 2.5. THE EIGHT PRINCIPLES OF QUALITY MANAGEMENT OF THE WMO QUALITY MANAGEMENT FRAMEWORK APPLIED TO WIGOS

1. USER AND CLIENT FOCUS

Members should identify, document and understand the current and future needs of their users and clients for meteorological, climatological, hydrological, marine and related environmental observations.

Note: The means to achieve this includes participation in and application of the WMO Rolling Review of Requirements (RRR) (see section 2.2.4 and Appendix 2.3).

2. LEADERSHIP

Members should clearly define the goals and directions of their observing systems, and create an environment in which staff are encouraged to work towards those goals.

Note: The relevant WMO technical commissions provide technical guidance and leadership for the implementation of WIGOS. They provide information on WIGOS goals and directions, and stimulate the active involvement of technical experts from Member countries.

3. Involvement of experts

Experts from Member countries should be fully involved in the implementation of regulations pertaining to WIGOS quality management.

4. PROCESS APPROACH

Members should adopt a process-based approach to management of observing systems.

5. SYSTEM APPROACH TO MANAGEMENT

Members should identify, understand and manage WIGOS component observing systems as sets of processes that may be operational, scientific or administrative, with the overall objective of producing the required observation outputs.

6. CONTINUAL IMPROVEMENT

Members should ensure that continual improvement is an integral and permanent aspect of WIGOS component observing systems and is implemented through a range of processes and activities that include active participation in the WMO RRR; auditing of observing systems and sites; data quality monitoring and evaluation; and routine consultation with, and review of feedback from, WIGOS users and application areas, primarily through the WMO RRR.

Note: The outcome is the improvement of either the quality of observations or the efficiency of observing systems.

7. FACTUAL APPROACH TO DECISION-MAKING

Members should ensure that decisions, requirements and regulations associated with the design, development, implementation, operation, maintenance and evolution of WIGOS component observing systems are based on scientifically, factually and analytically derived information.

Note: The abovementioned information is available to Members through tools such as the WMO RRR, the WIGOS Information Resource (WIR), the Observing Systems Capability Analysis and Review (OSCAR) tool, and through WMO endorsed planning documents such as *High-level Guidance on the Evolution of Global Observing Systems During the Period 2023–2027 in Response to the Vision for WMO Integrated Global Observing System (WIGOS) in 2040*. For further information see 2.2.4, Appendix 2.3 and Attachment 2.3.

8. MUTUALLY BENEFICIAL SUPPLIER RELATIONSHIPS

Members should share with each other and with suppliers information and results of tests, trials and intercomparisons of instruments and systems, for the mutual benefit of both WIGOS and suppliers.

Note: Suppliers of instruments, systems and related products should be evaluated and selected on the basis of their ability to meet requirements and the past performance of their products and services.

ATTACHMENT 2.1. SPECIAL OBSERVATIONS IN EXTRAORDINARY CIRCUMSTANCES

1. GENERAL

In some WMO application areas, the requirements for observations change as circumstances change. The circumstances might be a brief period of extreme, unexpected or dangerous conditions, or a longer-lasting event such as volcanic activity, a tropical cyclone or an environmental emergency such as a nuclear accident. Seasonal changes also allow Members to achieve efficiencies by adapting to changing requirements. The requirements might be for additional times/frequency of observations, additional spatial location or resolution, or the inclusion of additional meteorological and non-meteorological variables. There might also be additional reporting requirements.

In some cases, special observations might be primarily designed for use in numerical weather prediction (NWP) by targeting sensitive areas during a specific weather event. Research carried out within The Observing System Research and Predictability Experiment (THORPEX) found that improving forecasts of tropical cyclone tracks can have positive impacts. In other cases,

special observations might be primarily designed for use in other (non-NWP) modes of analysis and decision support.

2. SPECIAL OBSERVATIONS FOR TROPICAL CYCLONES

2.1 Aircraft weather reconnaissance flights

Members are encouraged to organize and share observations from aircraft weather reconnaissance flights for the analysis and prediction of developing or threatening tropical cyclones. Flight times and frequency should be selected to best supplement other upper-air and surveillance information.

These observations should include:

- (a) Altitude and position of aircraft;
- (b) Observations made at frequent intervals during a horizontal flight at low level;
- (c) Observations made during flights at higher levels, as near as possible to standard isobaric surfaces;
- (d) Vertical soundings, either by aircraft or by dropsonde.

The meteorological variables to be observed should include:

- (a) Atmospheric pressure at which the aircraft is flying;
- (b) Air temperature;
- (c) Humidity;
- (d) Wind (type of wind, wind direction and speed);
- (e) Present and past weather;
- (f) Turbulence;
- (g) Flight conditions (cloud amount);
- (h) Significant weather changes;
- (i) Icing and contrails.

Note that "type of wind" refers to how the wind was determined and whether it was a mean or a spot wind.

2.2 Other observations

Surface marine observations and sub-surface ocean temperature and salinity measurements are also very useful for predicting the track and intensity of tropical cyclones.

References for other special observations during tropical cyclones will be provided in a future edition of this Manual.

3. SPECIAL OBSERVATIONS FOR ENVIRONMENTAL EMERGENCY RESPONSE ACTIVITIES

The meteorological and non-meteorological (for example, radiological, sulphur dioxide, particulates, etc.) observational data requirements listed below have to be met to enable the designated Regional Specialized Meteorological Centres (RSMCs) to provide Members with transport model products for an environmental emergency response. These observational data, particularly at or near the site of an accident, are also needed by Members so that they may take appropriate preventive and remedial action in case of release into the environment. In the case of a nuclear emergency, data should be made available promptly in accordance with the Convention on Early Notification of a Nuclear Accident (Article 5 (e)).

A. Meteorological data requirements

- (1) The data needed to run transport models are the same as those specified for the production of weather forecasts based on numerical weather prediction models, and are given in the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485), 2.2.2.7, for nuclear environmental emergency response, and 2.2.2.8, for nonnuclear environmental emergency response.
- (2) Additional data¹ from the accident site² and potentially affected area³ are desirable, and should be available to the designated RSMC to improve the quality of information about the transport of pollutants. These should include:
 - (a) Wind, temperature and humidity, upperair data;
 - (b) Precipitation (type and amount);
 - (c) Surfaceair temperature;
 - (d) Atmospheric pressure;
 - (e) Wind direction and speed (surface and, in the case of a nuclear power plant, stack height);
 - (f) Humidity.
- (3) The following systems should be in place to provide the data needed from the accident site in combination, as necessary and (when) possible:
 - (a) In an emergency, at the stations closest to and up to 500 km from the site of the accident, the frequency of observations should be increased to at least every hour for the duration of the emergency. Stocks of consumables should be stored for use in an emergency;

¹ The words "additional data" are used with their usual meaning and not as in Resolution 1 (Cg-Ext(2021)) (World Meteorological Congress: Abridged Final Report of the Extraordinary Session (2021) (WMO-No. 1281)).

² Due to the wide variety of nuclear accidents, a precise definition of "accident site" is not possible. The accident site should be understood as the location where the accident occurs and the immediate surroundings within a range of a few kilometres.

³ The area potentially affected depends on the state and evolution of the atmosphere over an extended area around the accident site, as well as on the nuclear event itself, and so it cannot be precisely defined in advance. The "potentially affected area" should, therefore, be understood as the area where (according to the information available, including the air transport pollution products, if already known) the nuclear pollutants are likely to be transported in the air or on the ground at a significant level over the natural (background) radioactivity. Advice on the extent of the potentially affected area may be obtained from the RSMC concerned as well as national authorities.

- (b) In the case of a nuclear power plant, at least one radiosonde station should be located at a suitably safe distance, to enable continued operation in an emergency and to provide data representative of conditions at or near the accident site;
 - (c) In the case of a nuclear power plant, at least one surface station should be located at the site or, if this is not possible, at a nearby site. It should be convertible to an hourly automated mode for both operations and telecommunications in case of emergency;
 - (d) Additional information should be provided at or near the accident site by instrumented towers or masts (up to 100 m), where available, and by conventional or Doppler radars, SODARs, profilers, and boundary layer sondes, all with automatic transmission of data.
- (4) The data needed from the potentially affected area should be provided as follows:
- (a) All upperair stations within the potentially affected area should make observations every six hours for the duration of the emergency;
 - (b) Where possible, one or more additional observing systems (including wind profilers and mobile radiosounding equipment) and ascent/descent data from aircraft should be provided;
 - (c) All surface (land and marine) stations/platforms within the potentially affected area, including those that do not normally exchange data internationally, should provide observational data to designated RSMCs. These include marine platforms and buoys because they can provide coverage of sea areas;
 - (d) A series of best estimates of precipitation should be made by combining information from direct measurements (automated or manual) of surface stations, composite radar information extending over the whole WMO Region and satellitederived data.

B. Non-meteorological data requirements

- (1) In case of emergency, nonmeteorological data to be provided to designated RSMCs from the accident site should include:
- (a) Start of release (date and time);
 - (b) Duration;
 - (c) Radionuclide species (nuclear emergency) and type of pollutant (nonnuclear emergency);
 - (d) Total release quantity or pollutant release rate;
 - (e) Effective height of release.

Point (a) is necessary for running transport models, while (b), (c), (d) and (e) are desirable additional data.

- (2) In order to calibrate and validate the atmospheric transport model forecasts, data from potentially affected areas are needed. The most suitable data are:

Nuclear emergency:

- (a) For each isotope, concentration (Bq/h) and, if available, timeintegrated air concentration;

(b) Total deposition.

Nonnuclear -emergency:

This will depend on the pollutant and the nature of the release but, typically, measurements of the concentration would be appropriate.

(3) The required data from the accident site and potentially affected area may be obtained by the following means:

(a) Fixed monitoring stations;

(b) Mobile surface units;

(c) Sounding; or

(d) Instrumented aircraft.

The frequency of non-meteorological observations should be increased to at least once per hour.

C. Exchange of meteorological and non-meteorological data

- (1) Nonmeteorological data and, to some extent, additional meteorological data are likely to be provided by nonmeteorological national authorities. The National Meteorological or Hydrometeorological Services (NMSs) should encourage the provision of these data by nonmeteorological agencies/operators to National Meteorological Centres (NMCs) for onward transmission to their associated RSMCs.
- (2) In case of environmental emergencies, all relevant observational (meteorological and nonmeteorological) data should be transmitted to both RSMCs and NMSs through the WMO Information System (WIS) as quickly as possible. In the case of a nuclear emergency, radiological data available in the early phase of a nuclear accident that can help characterize the accident (containment radiation reading, onsite radiation levels, etc.) should be provided by national authorities to the International Atomic Energy Agency (IAEA) as soon as is practicable via the most reliable means of communication. The IAEA will verify and assess the information, and then provide these data to the appropriate RSMCs.
- (3) Endtoend testing of procedures for data acquisition, quality control and communication, and product dissemination should be carried out periodically to ensure system performance.

4. SPECIAL OBSERVATIONS IN THE EVENT OF VOLCANIC ACTIVITY

Requirements in the event of volcanic activity potentially hazardous to aviation should be related to the observational data needed by Members for taking appropriate action; these data are specified below.

The International Airways Volcano Watch (IAVW) is coordinated and developed by the International Civil Aviation Organization (ICAO) Secretariat with the assistance of ICAO Meteorology Panel. The *Handbook on the International Airways Volcano Watch (IAVW)* (ICAO Doc 9766-AN/968) describes the operational procedures and the contact list for the

implementation of the IAVW in the event of pre-eruption volcanic activity,¹ volcanic eruptions and volcanic ash clouds.

A. Meteorological data requirements

The data needed to run transport models are the same as specified for the production of weather forecasts based on numerical weather prediction models, and are given in the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485), 2.2.2.8.

- (1) Additional data² are desirable from the area in the vicinity of the volcano and should be made available to the designated Meteorological Watch Offices and Volcanic Ash Advisory Centre (VAAC)³ to improve the quality of information about the transport of volcanic ash. These data are the same as specified for the special observational requirements for environmental emergency response activities, and are given in this Attachment, section 3.
- (2) Imagery data from geostationary and polarorbiting satellites are required by the designated VAAC to ascertain whether a volcanic ash cloud is identifiable and to determine its extent (vertical and horizontal) (see the *Handbook on the International Airways Volcano Watch (IAVW)* (ICAO Doc 9766AN/968), Part 4. These data are also required to validate the transport model trajectory forecast and to determine when the volcanic ash has dissipated. The imagery data should:
 - (a) Be multispectral, covering visible and infrared wavelengths;
 - (b) Have adequate spatial resolution to detect small volcanic ash clouds (5 km or less);
 - (c) Have global coverage to provide data for all the VAACs;
 - (d) Have a frequent repeat cycle (30 minutes or less for the detection of volcanic ash and at least every six hours for the tracking of volcanic ash for transport model validation) (see *Handbook on the International Airways Volcano Watch (IAVW)* (ICAO Doc 9766AN/968), sections 4.5.1 (d) and 4.6.1 (d) and (e);
 - (e) Be processed and delivered to the VAAC with minimal delay.
- (3) Additional satellite data that can assist in the detection of preeruption volcanic activity, a volcanic eruption, or a volcanic ash cloud should be made available to the designated VAAC. These may include satellite data that can be used to detect volcanic hotspots or sulphur dioxide emissions.
- (4) Data obtained from surfacebased radar within range of the volcano should be made available to the designated VAAC. These data can be used to detect the presence of a volcanic ash cloud and measure its height.

B. Non-meteorological data requirements

- (1) The occurrence of preeruption volcanic activity, volcanic eruptions and volcanic ash clouds, because of the potential hazard to aviation, should be reported without delay to the designated Area Control Centres, Meteorological Watch Offices and VAAC, as described in the *Handbook on the International Airways Volcano Watch (IAVW)* (ICAO Doc

¹ Pre-eruption volcanic activity in this context means unusual and/or increasing volcanic activity, which could presage an eruption.

² The words "additional data" are used with their usual meaning and not as in Resolution 1 (Cg-Ext. 2021) (World Meteorological Congress: Abridged Final Report of the Extraordinary Session (2021) (WMO-No. 1281)).

³ Volcanic Ash Advisory Centres are designated by ICAO in coordination with WMO to issue advisories on the presence of volcanic ash and its forecasted trajectory.

9766AN/968). The report, in plain language, should be made in the form of a volcanic activity report comprising the following information, if available, in the order indicated:

- (a) Message type: VOLCANIC ACTIVITY REPORT;
 - (b) Station identifier, location indicator or name of station;
 - (c) Date/time of message;
 - (d) Location of volcano and name, if known;
 - (e) Concise description of event including, as appropriate, level of intensity of volcanic activity, occurrence of an eruption and its date and time, and existence of a volcanic ash cloud in the area (with the direction of ash cloud movement and height, as best estimated).
- (2) Available geological data that indicates the occurrence of preeruptive volcanic activity or a volcanic eruption should be passed immediately to the designated Area Control Centres, Meteorological Watch Offices and VAAC (see the *Handbook on the International Airways Volcano Watch (IAVW)* (ICAO Doc 9766AN/968), section 4.1.1 (d)). These data include:
- (a) Vulcanological observations;
 - (b) Seismological activity reports.
- (3) Pilot reports of preeruption volcanic activity, volcanic eruptions and volcanic ash clouds should be sent without delay to the designated Area Control Centres, Meteorological Watch Offices and VAAC (See the *Handbook on the International Airways Volcano Watch (IAVW)* (ICAO Doc 9766AN/968), section 4.1.1 (d)).

C. Exchange of meteorological and non-meteorological data

The exchange of all the above data is described in the *Handbook on the International Airways Volcano Watch (IAVW)* (ICAO Doc 9766-AN/968).

ATTACHMENT 2.2. WIGOS STATION IDENTIFIERS

1. STRUCTURE OF WIGOS STATION IDENTIFIERS

Figure 1 shows the structure of the WIGOS station identifier. The description of each component is given in the table below.

WIGOS station identifier series	Issuer of identifier	Issue number	Local identifier

Figure 1. Structure of the WIGOS station identifier

Component parts of the WIGOS station identifier

Component	Description	Initial range – series 0 (stations)
WIGOS station identifier series	This is used to distinguish between different systems for allocating identifiers. It allows future expansion of the system so that entities do not have to be issued with new identifiers if the structure of the WIGOS station identifiers proves unable to meet future requirements. Different values of the	0

	WIGOS station identifier series may correspond to different structures of the identifier. Initial permitted range: 0-14.	
Issuer of identifier	A number that is used to distinguish between identifiers issued by different organizations. It is allocated by WMO to ensure that only one organization can create a given WIGOS station identifier.	0-65534
Issue number	A number that an organization responsible for issuing an identifier may use to ensure global uniqueness of its identifiers. For example, allocating one issue number for hydrological stations and another for voluntary climate observing stations would enable the managers of the two networks to issue local identifiers independently without needing to check with each other that they were not duplicating identifiers.	0-65534
Local identifier	This is the individual identifier issued for each entity. An organization issuing identifiers must ensure that the combination of issue number and local identifier is unique; in that way global uniqueness is guaranteed.	16 alphanumeric characters

Notes:

1. The structure of WIGOS station identifiers has been designed to be general enough to identify other entities, such as individual instruments; however, this has not yet been implemented.
2. Although the table proposes initial ranges of permitted values of the components that make up a WIGOS station identifier, future changes in requirements may result in these ranges being increased. Information technology systems must, therefore, be designed to process identifiers whose components are of different lengths. BUFR encodings will need to be prepared for WIGOS station identifiers to allow efficient representation and these may use code lists to represent components of the identifier that are shared by many entities. Currently, WIGOS station identifier = 0.
3. Alphanumeric characters are the set of 62 characters including all the uppercase letters from A to Z, all the lowercase letters az and all the digits from 0 to 9. Symbols and special characters are not allowed in the set of alphanumeric characters to be used for the local identifier.

2. NOTATION FOR THE WIGOS STATION IDENTIFIER

The convention for writing WIGOS station identifiers (in the context of WIGOS) is:

<WIGOS station identifier series>-<issuer of identifier>-<issue number>-<local identifier>

Here is an example of a WIGOS station identifier:

WIGOS station identifier series 0	Issuer of identifier 513	Issue number 215	Local identifier 5678

which would be written as 0-513-215-5678.

3. REPRESENTING THE WIGOS STATION IDENTIFIER IN CONTEXTS OUTSIDE WIGOS

The following convention (Figure 2) should be used to represent the WIGOS station identifier outside WIGOS or to show the relationship between the WIGOS station identifier and an identifier that has been defined in a different context:

int.wmo.wigos	WIGOS station identifier	WIGOS supplementary identifier

Figure 2. Structure of an extended WIGOS station identifier

Both the int.wmo.wigos and the WIGOS supplementary identifier elements are optional.

int.wmo.wigos

The first component of the extended WIGOS station identifier (int.wmo.wigos) allows it to be recognized as a WIGOS station identifier when used in contexts where it may be unclear what type of identifier is being used. This is optional and need not be represented in BUFR, because the entries for the WIGOS station identifier provide this information;

WIGOS station identifier

The second component (WIGOS station identifier) is defined above. Within a WIGOS context it is the only component of the WIGOS station identifier that is always required;

WIGOS supplementary identifier

The final component (WIGOS supplementary identifier) is optional and is used to associate identifiers issued using other systems with the WIGOS unique identifier. A single WIGOS station identifier may be associated with many WIGOS supplementary identifiers (such as an observing site that is used for both synoptic and aviation reporting), and a WIGOS supplementary identifier may be associated with many WIGOS unique identifiers (such as a World Weather Watch drifting buoy identifier that has been issued to many drifting buoys). In BUFR, this would be indicated by a specific table entry (such as IIiii for World Weather Watch station identifier).

Note: If the above example of a WIGOS station identifier (05132155678) was also associated with an identifier (MYLOCATION) issued by another authority, a valid extended WIGOS station identifier would be int.wmo.wigos05132155678MYLOCATION.

4. ENTITIES RECOGNIZED AS ISSUERS OF IDENTIFIERS

The following entities are recognized as “Issuers of WIGOS Station Identifiers” (or WSI Issuers) with delegated authority to issue WSIs for observing stations that contribute to a WMO or co-sponsored programme on behalf of Members. Where there is a Member with a geographic area of responsibility, the Member should first be requested to issue a WSI for the station. If the Member does not provide a WSI, or does not reply, the WSI Issuer for the programme/organization concerned will issue the WSI; once that is done the Member should be informed.

- (1) The Comprehensive NuclearTestBan Treaty Organization (CTBTO);
- (2) The relevant authority for the observing component of the Global Atmosphere Watch (GAW);
- (3) The relevant authority for the observing component of the Global Cryosphere Watch (GCW);
- (4) The relevant authority for the Global Climate Observing System (GCOS) Reference UpperAir Network (GRUAN);
- (5) The WMO Radar Database (WRD), hosted by the Turkish State Meteorological Service (TSMS);
- (6) The Copernicus Climate Change Service (C3S) operated by the European Centre for MediumRange Weather Forecasts (ECMWF), on behalf of the European Union;
- (7) The relevant authority for the observing component of the WMO Hydrological Observing System (WHOS);
- (8) The WMO Aircraft-based Observations Metadata Repository (ABO-MR~~5~~₁);

(9) The relevant authority for the WMO Space Programme,(2) The relevant authority for the observing component of the Global Ocean Observing System (GOOS)

These WSI issuers will be given a distinct Issuer of Identifier code, for the second block in the WSIs structure, that clearly distinguishes them from those WSIs nationally issued by the Permanent Representatives of Members with WMO.

The relevant procedures for each entity mentioned above are described in the Guide to the WMO Integrated Global Observing System (WMO-No. 1165).

ATTACHMENT 2.3. THE WIGOS INFORMATION RESOURCE

1. PURPOSE

The WIGOS Information Resource (WIR) is a tool designed to provide WIGOS stakeholders (observing network decision-makers, managers, supervisors, implementation coordination groups and observational data users) with all relevant information on the operational status and evolution of WIGOS and its observing components, and their capabilities to meet the user observational requirements of the WMO application areas; the operational requirements of WIGOS, including standard and recommended practices and procedures; and on best practices and procedures used in the WIGOS framework. The WIR serves a number of purposes and brings the following benefits to WMO Members:

- (a) General information on WIGOS, its benefits to Members and the impact on Members of addressing WIGOS requirements;
- (b) An overall description of the WIGOS component observing systems that are currently in place (list of observing networks, stations, their characteristics (metadata) including information on the observational products they deliver);
- (c) Monitoring of the evolution of the observing systems to ascertain their progress in terms of the initial plans;
- (d) An outline of existing national and regional plans for evolution of WIGOS component observing systems;
- (e) Help, for Members and those in charge of designing and implementing observing networks, in understanding the requirements for the relevant observing systems, including standard and recommended practices and procedures and user observational requirements, in order for them to make appropriate decisions;
- (f) Assistance for Members in identifying observational gaps through critical review and in conducting network design studies, in order for them to address those gaps;
- (g) Help for Members in grasping the full potential of the current observing systems, including those operated by partner organizations, with regard to the WMO application areas, in order to enhance: (a) the scope and availability of observations made by specific observing stations; (b) collaboration; (c) data sharing; and (d) data exchange;
- (h) Immediate access for data users to the list of WIGOS component observing systems and a basic set of observational metadata for each (specified by WMO Technical Regulations), with links to the appropriate national databases, where these exist, which contain more detailed information;
- (i) Guidance for developing countries on observing network implementation, providing them with tools they can readily use to document their own observing systems (for example, by

using the Observing Systems Capability Analysis and Review (OSCAR) tool of the WIR, they would not need to develop a national database);

- (j) A mechanism for matching specific needs (capacity building, closing gaps, etc.) with resources (via knowledge sharing, donor contributions, etc.).

Notes:

1. The term observing station refers to any type of observing site, station or platform relevant to WIGOS, whether they are surfacebased or spacebased, on land, at sea, in a lake, river or in the air, fixed or mobile, and making in situ or remote observations.
2. Gaps are expressed in terms of required space and time resolution, observing cycle, timeliness and uncertainty for the WMO application areas.

2. THE OBSERVING SYSTEMS CAPABILITY ANALYSIS AND REVIEW TOOL

The Observing Systems Capability Analysis and Review tool of the WIR is a key source of information for WIGOS metadata. The surface- and space-based components of OSCAR are intended to record observing platform/station metadata, according to the WIGOS Metadata Standard described in the present Manual and in the WIGOS Metadata Standard (WMO-No. 1192), and to retain a record of the current and historical WIGOS metadata.

The space-based component of OSCAR has a long history which precedes the development of the WIGOS Metadata Standard; therefore, while it strives to achieve consistency, there will be some differences between its structure and the Standard.

The third component of OSCAR is the database of user requirements for observations. It contains the technology-free requirements of each WMO application area. Requirements of an application area for geophysical variables, in specified vertical layer/s with specified horizontal coverage, are expressed in terms of criteria such as space and time resolution, uncertainty and latency (Appendix 2.3 provides further details).

The requirements are regularly reviewed by groups of experts nominated by the organizations and WMO Programmes and Co-sponsored Programmes contributing to the RRR process. For WMO, this process is conducted by the Joint Expert Team on Earth Observing System Design and Evolution (JET-EOSDE) and its designated Points of Contact for each of the application areas.

3. MANAGEMENT OF THE OBSERVING SYSTEMS CAPABILITY ANALYSIS AND REVIEW TOOL

The management of OSCAR (for example, its functional specifications and their evolution) and its components is overseen by the WMO Secretariat in liaison with relevant expert groups and bodies, and in accordance with the WIGOS standards that have been agreed upon and recommended practices and procedures.

4. CONTENT MANAGEMENT OF THE OBSERVING SYSTEMS CAPABILITY ANALYSIS AND REVIEW TOOL

The WIGOS metadata are under the authority of the Permanent Representatives with WMO.

The operator of OSCAR will collect feedback from Members on noted discrepancies, possible errors and required changes, so that the information content of OSCAR reflects the reality of the surface- and space-based capabilities of the observing platforms/stations they operate, including instrument and platform/station metadata.

The WMO Secretariat is responsible for coordinating management of the information content of OSCAR, with assistance from designated experts and Points of Contact.

Current information can be found at <https://community.wmo.int/oscar> and <https://community.wmo.int/oscar-wmo-observational-requirements-and-capabilities>.

ATTACHMENT 2.4. THE WIGOS DATA QUALITY MONITORING SYSTEM

The WIGOS Data Quality Monitoring System (WDQMS) consists of:

- The WIGOS Quality Monitoring Function;
- The WIGOS Evaluation Function;
- The WIGOS Incident Management Function.

These three functions define the scope of WDQMS.

The high-level WDQMS functional diagram

Entities or bodies undertaking WDQMS functions

The WDQMS functions can be undertaken by one, two or three separate bodies: the number of bodies may vary depending on the WIGOS observing component being considered. ~~These bodies will be known as~~ The WIGOS Quality Monitoring Function is undertaken by the WIGOS Quality Monitoring, ~~the WIGOS Evaluation and the WIGOS Incident Management~~ Centres, ~~respectively.~~

~~In the case of the land stations of GOS, the~~ The WIGOS Evaluation Function and Incident Management Function ~~will be~~ are undertaken by Regional WIGOS Centres (RWC)¹ to cover a whole WMO Region or a subregion.

Where a quality monitoring, evaluation or incident management function is best undertaken on a global basis, for example, for ozone observations, a thematic or global centre or centres² should be established.

The exact nature of the configuration of the three functions and the selection of global or regional centres will be most strongly informed by the common operating practice implemented within that sub-component of the WIGOS observing components and co-sponsored observing systems.

The WIGOS Quality Monitoring Function

The WIGOS Quality Monitoring Function will:

- Compare the observational data received at the WIGOS Quality Monitoring Centre³ against agreed user requirements for observational data. These agreed requirements will

¹ Further guidance on RWCs is provided in the Guide to the WMO Integrated Global Observing System (WMO-No. 1165), Chapter 8.

² Thematic or global WIGOS centre (T/GWC): a WMO centre (physical, virtual or distributed) in charge of one or more of the WDQMS functions with a global scope for a specific WIGOS observing system/component.

³ WIGOS quality monitoring centre (WQMC): a WMO centre (physical, virtual or distributed) in charge of the WIGOS Quality Monitoring Function with a global or regional scope for one or more WIGOS observing systems/components.

include availability, timeliness of delivery and observational data quality, including completeness;

- Require access to the official sources of observational metadata, for example, [OSCAR/Surface](#) for the surfacebased observations, for the internationally exchanged observations that will be assessed;
- Generate reports of results of comparisons of the received data with the expected availability, timeliness and observational quality criteria. These reports will be in predefined formats following agreed generation and dissemination criteria;
- Publish the reports generated, in the context of agreed data access rules;
- Generate statements of fact based on data and evidence rather than subjective judgements on observing system performance.

The WIGOS Evaluation Function

The WIGOS Evaluation Function:

- Will take the outputs of the WIGOS Quality Monitoring Function and any other relevant information to check them in context and determine if there is an issue with the observational data received at the WIGOS Quality Monitoring Centre or some other component of WIGOS, such as the metadata records held in [OSCAR/Surface](#);
- May also act on information supplied from other sources, such as the WMO Information System (WIS) or individual Members, and may use that information and other sources to determine if an issue exists;
- Will use agreed business rules to determine if any issues identified require an incident to be raised with the appropriate operating authority (data providers) for the observational data;
- Will pass the request for an incident to be raised, along with all the supporting information, to the Incident Management Function for implementation;
- Will compile routine reports on the quality of the observational data received by the WIGOS Quality Monitoring Function for the operating authorities and data users. The frequency of this reporting will vary depending on the specific WIGOS component observing system under consideration.

The WIGOS Incident Management Function

The WIGOS Incident Management Function will:

- Flag an incident in accordance with a request from the WIGOS Evaluation Function, forward the Incident Ticket thus generated, with all appropriate additional information, to the relevant observing system operating authority, and track progress in the incident investigation and resolution;
- Support, as appropriate, the observing system operating authority during investigation and resolution of the incident;
- Maintain a record of all incidents raised and the activities undertaken to resolve the incidents, making this information available to Members as a knowledge base for future incident resolution;
- Make available to the observational data users information about progress in the investigation and resolution of incidents.

Operating practices for WDQMS and its functions

To ensure consistency of quality monitoring, evaluation and incident management action, compliance with the operating practices and procedures associated with the WDQMS will need to be carefully monitored.

Operating practices and procedures to be followed by the quality monitoring centres will be developed by the working entity in charge of WDQMS.

Operating practices and procedures to be followed by a Regional WIGOS Centre (RWC) will be developed by the respective regional association or respective RWC oversight bodies.

Operating practices and procedures to be followed by thematic or global centres will be developed by their oversight or governance bodies.

Technical Guidelines for Regional WIGOS Centres on the WIGOS Data Quality Monitoring System (WMO-No. 1224) provides detailed technical guidance for RWCs to run the operational activities related to the WDQMS, specifically for ~~the surface stations of the Global Observing System (GOS) located on land (on the territories of Members of WMO regional associations).~~

3. ATTRIBUTES SPECIFIC TO THE SURFACEBASED SUBSYSTEM OF WIGOS

3.1 REQUIREMENTS

Note: The user observational requirements of WMO application areas are expressed in a technologyfree manner, hence they apply to all of WIGOS, not to any specific subsystem. The provisions of section 2.1 apply across all WIGOS subsystems.

3.2 DESIGN, PLANNING AND EVOLUTION

3.2.1 Composition of the surfacebased subsystem of WIGOS

3.2.1.1 The WIGOS surface-based subsystem shall be composed of surface stations within the component networks (GOS, GAW, WHOS, GCW).

Notes:

1. A prominent element of the WIGOS surfacebased subsystem is the Regional Basic Observing Network (RBON) as described in 3.2.3. Other elements generally exist within one of the component networks as described in sections 5–8.
2. Information regarding the current capabilities of the surfacebased subsystem is to be available through OSCAR at <https://community.wmo.int/oscar> and <https://community.wmo.int/oscarwmoobservationalrequirementsandcapabilities>. This information includes the list of surface stations/platforms that compose the WIGOS surfacebased subsystem.

3. The term "Surface station" includes all surface-based observations.

3.2.2 Global Basic Observing Network

3.2.2.1 The Global Basic Observing Network (GBON) shall be a subset of the surface-based subsystem of WIGOS, used in combination with the space-based subsystem and other surface-based observing systems of WIGOS, to contribute to meeting the requirements of Global NWP, including reanalysis in support of climate monitoring.

3.2.2.2 Members shall establish and manage GBON.

Notes:

1. Global NWP provides an essential backbone for all products and services provided by all WMO Members. The geographically relevant component of GBON provides an essential base component within each Regional Basic Observing Network (see 3.2.3 ~~below~~).
2. GBON is based on a global design and the implementation is monitored globally.
3. GBON is designed to respond primarily to those Global NWP requirements that are currently not met, or not fully met, by spacebased systems.
4. The specification for GBON is laid out in provisions 3.2.2.7–3.2.2.20. These are derived from the observational requirements for Global NWP that are recorded in the [OSCAR/Requirements](#) database together with an analysis of the operational technologies for collecting such observations and availability of observations from other sources. The technical assessment is conducted for the World Meteorological Congress by the Commission for Observation, Infrastructure and Information Systems (INFCOM).
5. To support climate monitoring, the design of GBON needs to consider the Climate Monitoring Principles of the Global Climate Observing System (see Appendix 2.2), in particular the sustainability of uninterrupted historical climate observations. The GCOS Surface Network (GSN) and GCOS Upper-Air Network (GUAN) are the defined networks for long-term in-situ (land surface and upper-air) observations.

3.2.2.3 Members shall maintain the continuous operation of those stations/platforms that are designated as contributors to GBON ~~in accordance with Appendix 3.1.~~

Note: The ~~designation assignment~~ process ~~for GBON stations~~ is defined in 3.2.2.22–3.2.2.23 ~~below~~ and further detailed in the Guide to the WMO Integrated Global Observing System (WMONo. 1165).

3.2.2.4 Members shall strive to design, install, manage, and operate stations within their networks in an environmentally sustainable fashion.

3.2.2.5 Members shall make available internationally through WIS all GBON observations in real time or near-real time according to the overall WMO data policy.

3.2.2.6 If a Member finds that the horizontal and/or temporal resolution required according to one or more of provisions 3.2.2.73.2.2.18 is not practically achievable for the observing network within parts of their territory, the Member shall inform the SecretaryGeneral of the reasons as per Article 9(b) of the [WMO Convention](#), and the Technical Regulations (WMONo. 49), Volume I, General Provisions, paragraph 6.

Note: See the "~~Guide to GBON~~", in the ~~Guide to the WMO Integrated Global Observing System (WMO-No. the Guide to the WMO Integrated Global Observing System (WMO-No. 1165)~~, Chapter 11, for further details.

3.2.2.7 Members shall maintain the continuous operation of a set of surface land stations/platforms that observe, at a minimum, atmospheric pressure, air temperature, humidity, horizontal wind, precipitation and snow depth, where applicable, located such that GBON has a horizontal resolution of 200 km or higher for all of these variables, with an hourly frequency.

Notes:

1. The precipitation observation means an hourly accumulation.
2. The snow depth measurement is reported in accordance with the provisions of 5.1.6 and 5.1.7 of this Manual.
3. The Guide to Instruments and Methods of Observation (WMONo. 8), ~~Volume II~~ provides details on ~~the~~ measurement of ~~snow~~ all variables specified under this provision.
4. A horizontal resolution of 200 km or higher means that stations/platforms are spaced not more than 200 km apart on average.
5. Many manual stations/platforms observe less frequently than hourly; these nevertheless provide a valuable contribution to GBON.

6. The provisions do not imply that every station/platform must measure all the variables listed, but that the network as a whole delivers observations at the required horizontal resolution for all the variables.

~~7. For Members whose surface area of the Exclusive Economic Zone (EEZ) is significantly larger than the land surface area, the horizontal resolution defined in 3.2.2.10 applies to the entirety of the area of observing responsibility, including land surface and EEZ.~~

3.2.2.8 Members should operate surface land observing ~~networks~~stations/platforms at horizontal resolutions of 100 km or higher.

3.2.2.9 Where Members operate networks as described in 3.2.2.7 and 3.2.2.8, Members shall make the observations of these networks available internationally according to 3.2.2.5.

3.2.2.10 Where applicable, Members shall maintain the continuous operation of a set of surface marine meteorological observing stations/platforms within their Exclusive Economic Zone, or the corresponding marine areas of their jurisdictions, that observe, at a minimum, atmospheric pressure and sea surface temperature, located such that where opportunity exists, GBON has a horizontal resolution of 500 km or higher, over the marine areas of their jurisdictions, for these variables, with an hourly frequency.

~~Note: For small island developing States where the surface area of the Exclusive Economic Zone is significantly larger than the land surface area, this provision applies to the entirety of the area of observing responsibility.~~

3.2.2.11 Where applicable, Members should facilitate other Members sharing surface marine meteorological observations within their Exclusive Economic Zone, or the corresponding marine areas of their jurisdictions, subject to the data being made available internationally according to 3.2.2.5.

3.2.2.12 Members shall maintain the continuous operation of a set of upper-air stations/platforms over land that observe, at a minimum, temperature, humidity and horizontal wind, with a vertical resolution of 100 m or higher, twice a day or better, up to a level of 30 hPa or higher, located such that GBON has a horizontal resolution of 500 km or higher for these observations.

Notes:

1. Radiosonde systems currently provide the primary means for collecting such observations.
2. A vertical resolution of 100 m or higher means that observations are spaced and reported not more than 100 m apart in the vertical on average.
3. Upperair observations obtained over remote/isolated islands have a particularly high impact on Global NWP skill, and continued operation of these stations/platforms is of high priority for GBON.

3.2.2.13 Members should operate networks of upper-air stations/platforms providing horizontal resolutions of 200 km or higher.

3.2.2.14 Members should operate a subset of the selected GBON upper-air observing stations/platforms that observe temperature, humidity and horizontal wind up to 10 hPa or higher, at least once per day, located such that, where geographical constraints allow, GBON has a horizontal resolution of 1 000 km or higher, for these observations.

3.2.2.15 Members shall operate a set of upper-air stations/platforms that observe temperature, humidity and horizontal wind, with a vertical resolution of 100 m or higher, twice a day or better, up to 30 hPa or higher, located such that, where opportunity exists, GBON has a horizontal resolution of 1 000 km or higher over the marine areas of their jurisdictions, for all these observations.

Note: For ~~small island developing States where the~~ Members whose surface area of the Exclusive Economic Zone is significantly larger than the land surface area, this provision applies to the entirety of the area of observing responsibility.

3.2.2.16 Where networks described in 3.2.2.10 and 3.2.2.12–15 are operated, 3.2.2.5 shall apply.

3.2.2.17 Members should make available aircraft meteorological observations of temperature, humidity (where available) and horizontal wind from aircraft ascents and descents, with 300 m or higher vertical resolution with an hourly frequency or higher.

Note: For aircraft meteorological observations received from any source, conditions on the use, re-use and sharing of such data may be applied by licensing agreements or other appropriate arrangements.

3.2.2.18 Members should make available aircraft meteorological observations of temperature, humidity (where available) and horizontal wind, with a horizontal resolution of 100 km or higher, while at level flight.

Note: Note under 3.2.2.17 applies.

3.2.2.19 Members should make available hourly remote-sensing profiler observations of temperature (where available), humidity (where available) and horizontal wind with a vertical resolution of 100 m or higher.

3.2.2.20 Members operating observing ~~networks~~ stations/platforms at higher density than specified above under the provisions 3.2.2.7–3.2.2.19 should make available what is observed at least hourly.

~~Note: 15 km is the current goal of Global NWP requirements.~~

3.2.2.21 Members shall make available the metadata of their GBON observing stations/platforms in accordance with the provisions of section 2.5.

3.2.2.22 Each Member shall ~~designate~~ assign to GBON at a minimum the required number of surface stations/platforms and the required number of ~~upper air~~ upper air stations/platforms as per 3.2.2.7–3.2.2.10 and 3.2.2.12–3.2.2.15 as their contribution to GBON.

~~Note: See Note 3 below 3.2.2.12.~~

3.2.2.22bis Members should operate GBON stations/platforms in areas of global commons including the High Seas and the Antarctic.

3.2.2.23 Members shall register the stations/platforms in **OSCAR/Surface** and identify that these stations/platforms belong to GBON.

3.2.2.24 Members shall routinely monitor GBON performance across the network to identify non-conformance with the designed performance.

Note: Guidance on data quality monitoring, evaluation and incident management is detailed in the Guide to the WMO Integrated Global Observing System (WMONo. 1165), Chapter 8.

3.2.2.25 Members shall acknowledge, document and rectify any identified non-conformance at one of their stations/platforms within time frames agreed by the WMO Executive Council or the World Meteorological Congress.

Note: Details on relevant time frames and processes are provided in the Guide to the WMO Integrated Global Observing System (WMONo. 1165).

3.2.2.26 Members shall formally notify the Secretary-General, at least three months in advance, of their plan to discontinue the operation of their stations/platforms.

3.2.3 Regional Basic Observing Network

3.2.3.1 Members shall establish and manage the RBON in their Region and the Antarctic.

Notes:

1. The former Regional Basic Synoptic Network (RBSN) and Regional Basic Climatological Network (RBCN) in each Region were the predecessors of RBON. The previous focus on the requirements of synoptic meteorology and climate monitoring is ~~now~~ expanded to ~~include all~~ address any of the WMO application areas. Similarly, the network of synoptic and climatological stations is ~~now~~ expanded with the inclusion of other stations/platforms which should contribute to RBON, for example, aircraft stations.
2. The former Antarctic Observing Network (AntON) was the predecessor of RBON in the Antarctic; ~~this~~ RBON in the Antarctic will be managed by Members that contribute observations in the Antarctic to WIGOS.

~~3.2.3.23.~~ RBON is designed by the regional associations and in case of the Antarctic by the Executive Council, in consultation with Members. Guidance on the process and principles for the design of RBON is provided in the Guide to the WMO Integrated Global Observing System (WMO No. 1165), Chapter 12.

3.2.3.2 Members shall design RBONs in response to user observational requirements as compiled in the OSCAR/Requirements database, in consideration of the identified regional challenges for RBON.

Notes:

1. Section 2.2 contains general provisions for the design of WIGOS and its components, including RBON, in response to user requirements.
2. The observing network design principles specified in Appendix 2.1 and the nonsatellite parts of Appendix 2.2 apply also to the design of the RBON.

3.2.3.3 Members shall design RBONs using existing observing systems within WIGOS in the Regions and the Antarctic.

~~3.2.3.34~~ Members shall ~~nominate~~ assign an observing station/platform for inclusion into RBON only if it meets one or more requirements of one or more WMO application areas, according to weather, water, climate and other environment challenges to be addressed with RBON data as decided by the regional associations, or in case of the Antarctic by the Executive Council.

Notes:

1. WMO application areas have a range of requirements, as explained further in ~~Attachment Appendix 2.3.1~~. The greater the number of requirements met by a station/platform, the greater its value in general for inclusion in RBON.
2. Attention must be given to a ~~multistation~~ multistation or regional level assessment of "horizontal resolution", since this component of the requirements is met by the network, not by any individual station/platform.
3. Each regional association and the Executive Council for the Antarctic are requested to identify and agree on a small number of weather, water, climate and environment challenges to be addressed with RBON data in their region and the Antarctic, respectively.
4. Unlike RBON, the requirements addressed by GBON are global and therefore common to all regions and the Antarctic. All GBON stations are considered to also be RBON stations.
5. Each regional association and the WMO Executive Council may wish to maintain a working body whose role includes compilation and analysis of nominations from Members, identification of gaps or deficiencies in the resulting RBON design compared to user requirements, and an action plan to deal with such gaps, so that it can make informed decisions about the RBON at its sessions.
6. Each regional association and the WMO Executive Council need to maintain detailed technical coordination with INFCOM.
7. Only stations/platforms registered in OSCAR/Surface can be assigned to RBON, by Members.
8. The regional association decides on a plan or roadmap for the evolution of RBON to fill the remaining gaps.

3.2.3.45 Members shall ~~nominate~~assign an observing station/platform ~~for inclusion into~~ RBON only if it makes observations available for international exchange in real time or near-real time.

3.2.3.56 Members shall ~~nominate~~assign an observing station/platform ~~for inclusion in RBON to RBON~~ only if there is a commitment to operate it for at least four (4) years.

Notes:

1. Sustainability over at least a tenyear period is recommended, see 2.2.1.2.
2. For fixed stations/platforms, the commitment is to observe at the nominated location, whereas for mobile types the commitment is to sustain a nominated density of observations over a given domain (point, line, area or volume) that may be achieved by (a) controlling the movement of a group of stations/platforms, for example, by relocations, or (b) periodic deployment of new mobile stations/platforms within the given domain.
3. Four years is the current cycle of a major review of RBON. This may change in the future.

~~3.2.3.6 Members shall design RBONs in response to user observational requirements as compiled in the OSCAR/Requirements database, in consideration of regional needs.~~

Notes:

1. ~~Section 2.2 contains general provisions for the design of WIGOS and its components, including RBON, in response to user requirements.~~
2. ~~The design principles specified in Appendix 2.1 and the nonsatellite parts of Appendix 2.2 apply also to the design of the RBON.~~

3.2.3.7 Members shall each ~~nominate~~assign a set of stations/platforms to ~~RBON to enable RBONs to that the observational requirements of key variables for the all WMO application areas that address the identified regional challenges for RBON, are meet,~~ at threshold levels or better, ~~the observational requirements of all WMO application areas.~~

Notes:

1. The terms threshold, breakthrough and goal in the context of observational data requirements are defined in OSCAR/Requirements and described further in ~~Attachment Appendix 2.3.1.~~
2. When ~~making~~assigning their ~~nominations~~stations, Members may take into account other WIGOS observations available within RBON ~~and~~and in addition to RBON such as ~~spacebased~~spacebased observations.
3. The relative priority given to different application areas and achieving performance significantly above the threshold levels may take account of regional priorities. However, there is a global priority to support numerical weather prediction (NWP) which in turn supports many other WMO ~~applications~~application areas.

3.2.3.8 Members should include in their set of stations/platforms ~~nominated for the~~assigned to RBON, capabilities that enable RBONs to meet observational requirements of at least some application areas at the breakthrough level or better.

3.2.3.9 Within their set of stations/platforms ~~nominated for the RBON, Members shall include a subset consisting of stations/platforms that observe surface variables with an hourly or more frequent observing cycle, sufficient to meet the threshold observing cycle requirements of all application areas.~~

Note: ~~While a sufficient number of hourly observation stations/platforms is needed to enable a RBON to meet the threshold observing cycle requirements of all application areas, further stations/platforms with a lower frequency of surface observations may also help the RBON to meet a number of other requirements.~~

~~3.2.3.10 Within their set of stations/platforms nominated for the RBON, Members should include enough stations/platforms that observe surface atmospheric pressure to enable the RBON to have horizontal resolution of 100 km or better for surface pressure observations.~~

~~assigned to~~ **Notes:**

- ~~1: A desirable level of horizontal resolution for surface atmospheric pressure observations is 100 km or better. Such resolution would meet the breakthrough requirements for Global NWP and Climate Monitoring, and also the threshold requirements of some but not all WMO application areas.~~
- ~~2: This provision is most difficult to satisfy over remote areas and oceans, where efforts may be aided by automatic weather stations on land and at sea, and inclusion of atmospheric pressure observations from drifting buoys.~~

~~3.2.3.11 Within their set of stations/platforms nominated for the RBON, Members should include enough upper air stations/platforms to enable the RBON to have horizontal resolution of 100 km or better for horizontal wind profile observations.~~

~~Notes:~~

- ~~1: A desirable level of horizontal resolution for wind (horizontal) profile observations is 100 km or better in the following domains: lower troposphere, high troposphere, and lower stratosphere. Such resolution would meet the breakthrough requirements for Global NWP and Climate Monitoring (GCOS) and also the threshold requirements of several other WMO application areas.~~
- ~~2: Although RBONs may provide tropospheric wind (horizontal) profile observations from a range of technologies, only balloon tracking systems provide profiles in the lower stratosphere. Typically, these are radiosonde systems.~~
- ~~3: This provision is most difficult to satisfy in the lower stratosphere and over remote areas and oceans. Efforts in remote areas may be aided by the use of automatic systems including radar wind profilers and aircraft meteorological stations. For profile observations in the lower stratosphere, efforts may be aided by the use of automatic balloon release systems and participation in Automated Shipboard Aerological Programmes (ASAPs) with the cooperation of voluntary ships and research vessels.~~

~~3.2.3.12 Within their set of stations/platforms nominated for the RBON, Members should include enough weather radars to enable the RBON to improve Global NWP for precipitation and wind in geographical areas where such improvements bring socioeconomic benefits.~~

~~3.2.3.13 Members shall nominate their proposed contributions to the RBON in their respective region for approval by the regional association or, in the case of the Antarctic, the WMO Executive Council or Congress.~~

~~3.2.3.10~~ **Notes:**

- ~~1: Each regional association and the WMO Executive Council may wish to maintain a working body whose role includes compilation and analysis of nominations from Members, identification of gaps or deficiencies in the resulting RBON design compared to user requirements, and an action plan to deal with such gaps, so that it can make informed decisions about the RBON at its sessions.~~
- ~~2: Each regional association and the WMO Executive Council need to maintain detailed technical coordination with INFCOM.~~
- ~~3: Only stations/platforms registered in OSCAR can be nominated.~~
- ~~4: The proposed nominations of RBON stations by Members are made in OSCAR/Surface, where they are recorded in "Pending Approval" mode. INFCOM, assisted by the Secretariat, reviews the proposals, and makes a recommendation to the regional association (or Executive Council or Congress, in the case of Antarctica) on the updated RBON composition. The proposed changes in the RBON composition are made available through a dedicated WMO website tool to all Members of the respective regional association three months before a regional association session. Based on the feedback provided by Members, a final version of the proposed changes in the RBON composition is submitted to the regional association session based on the information in the dedicated WMO website tool. The regional association decides on an updated RBON composition and a plan or roadmap for the evolution of RBON to fill the remaining gaps.~~
- ~~5: In accordance with the Basic Documents No. 1 (WMO No. 15), Regulation 59, the regional association authorizes its president to approve, at the request of the Member concerned, and on the recommendation from the regional association/Working Group on Infrastructure (WG-I) and in consultation with the Secretary General, minor amendments to the list of RBON stations without formal consultation with the Members of the regional association. However, any change of substance adversely affecting the design of RBON in response to user~~

~~observational requirements would still require the formal agreement of Members through the adoption of a resolution by voting by correspondence.~~

~~3.2.3.14~~ Members should work together in their regional association to identify and address gaps in their RBON, or in the WMO Executive Council in the case of the Antarctic.

Notes:

1. Guidance on the priority to be given to different types of gap may be found in the Statements of Guidance (SOGs) produced by the RRR, as described in Appendix 2.3 and available on the WMO website at <https://community.wmo.int/rollingreviewrequirementsprocess>.
2. Relative priorities between the various requirements of an application area may be recorded in OSCAR/Requirements in the future. In addition to the SoGs, these priorities may assist Members to decide which gaps to tackle with higher priority.
3. The general provisions for capacity development laid out in section 2.7.1 are relevant.

3.2.3.15~~11~~ Members shall contribute to the regular review of the composition of the RBON to address evolving requirements for observations.

Note: Regular may be interpreted as at least once between sessions of the regional association or, in the case of the Antarctic, between sessions of Congress.

~~3.2.3.16 Members should request the president of the regional association, or the president of WMO in the case of the Antarctic, that minor amendments be made to the composition of the RBON whenever they are required.~~

Notes:

- ~~1. The process for dealing with such a request is specified by each regional association or, in the case of the Antarctic, by the WMO Executive Council. In general, the president of the regional association or the president of WMO approves, at the request of the Member concerned, on the advice of the chair of the respective subsidiary body and in consultation with the Secretary General, minor amendments to the RBON. Any change of substance would still require the formal agreement of Members of the respective Region or of those Members operating components of the RBON in the Antarctic.~~
- ~~2. A minor amendment is not one of substance, that is, not one that would adversely affect the density of the network or cause a significant change in observational hours.~~ Notes:
3. Regional practices are described further in the Guide to the WMO Integrated Global Observing System (WMONo. 1165).
- ~~4. Members are notified of changes by the WMO Secretariat through the Operational Newsletter or by circular letter.~~

3.2.3.17~~12~~ Members working together in the regional association, or the WMO Executive Council in the case of the Antarctic, shall routinely monitor RBON performance across the network to identify non-conformance with the designed performance.

Notes:

1. As indicated in 3.2.3.3–3.2.3.6 above, RBON is designed to respond to requirements for observations of the WMO application areas [addressing specific regional challenges](#).
2. A regional association may wish to undertake this task through a Regional WIGOS Centre (RWC), as described in the Guide to the WMO Integrated Global Observing System (WMONo. 1165), Chapter 8. A key source of information are global/regional centres undertaking a WIGOS Quality Monitoring Function.
3. Guidance on data quality monitoring, evaluation and incident management is detailed in the Guide to the WMO Integrated Global Observing System (WMONo. 1165), Chapter 9. Note, in particular, the description of the WIGOS Data Quality Monitoring System.

3.2.3.18~~13~~ Members shall acknowledge, document and rectify any identified non-conformance at one of their stations/platforms within time frames agreed by

the respective regional association or, in the case of the Antarctic, by the WMO Executive Council or Congress.

Notes:

1. Where rectification actions extend over a long period, the Member is to provide regular reports on progress.
2. When an identified nonconformity persists, the president of the regional association, or President of WMO, may review the likelihood of rectification and, in consultation with the relevant Member, decide whether to remove the station/platform from the RBON ~~between sessions of the regional association, or the Executive Council.~~
3. Details ~~of~~ on relevant ~~time frames and~~ processes are provided in the ~~Technical Guidelines for Regional WIGOS Centres on the WIGOS Data Quality Monitoring System~~ Guide to the WMO Integrated Global Observing System (WMONo. 1224 WMONo. 1165).

3.2.3.1914 Members should continue to operate the former RBCN stations as RBON stations addressing climate monitoring requirements.

3.2.3.2015 Members shall report observations from the RBON stations that are meant to address the climate monitoring requirements on a monthly basis, according to the Manual on Codes (WMO-No. 306), Volume I.2, ~~regulations B/C30 and B/C32, as appropriate.~~

Notes: Guidance on the process for RBON design process by regional associations and the Executive Council is provided in the Guide to the WMO Integrated Global Observing System (WMONo. 1165).

3.3 INSTRUMENTATION AND METHODS OF OBSERVATION

3.3.1 General requirements

3.3.1.1 Members shall classify their surface meteorological and climatological observing stations on land.

Note: The Guide to Instruments and Methods of Observation (WMONo. 8), Volume I, Chapter 1, 1.1.2, and Annex 1.D, defines a classification scheme for surface observing sites on land indicating their representativeness for the measurement of different variables. The content of Annex 1.D will be included as an appendix in a future edition of the present Manual.

3.3.1.2 Members should locate each observing station at a site that permits instrument exposure in line with the requirements of the specific application and also enables satisfactory non-instrumental observations.

Notes:

1. The Guide to Instruments and Methods of Observation (WMONo. 8), Volume I, Chapter 1, Annexes 1.D and 1.F, provides further guidelines.
2. Requirements for GAW stations are formulated in section 6.

3.3.1.3 Members shall accurately ascertain the position of a station referring to the World Geodetic System 1984 (WGS-84) and its Earth Geodetic Model 1996 (EGM96).

Notes:

1. Guidelines are provided in the Guide to Instruments and Methods of Observation (WMONo. 8), Volume I, Chapter 1, 1.3.3.2.
2. The WGS84 is currently not in general use in hydrology. Its description will be included as an appendix in a future edition of the present Manual.

3.3.1.4 Members shall define the elevation of the station.

Note: The Guide to Instruments and Methods of Observation (WMONo. 8), Volume I, Chapter 1, 1.3.3.2(c), specifies how to define the elevation of a station. This material will be included as an appendix in a future edition of the present Manual.

3.3.1.5 If a station is located at an aerodrome, Members shall specify the official elevation of the aerodrome in accordance with the Technical Regulations (WMO-No. 49), Volume II.

3.3.1.6 Members operating Regional Instrument Centres should follow the relevant specifications concerning capabilities and corresponding functions.

Note: The Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Annex 1.C, specifies capabilities and corresponding functions for Regional Instrument Centres. This material will be included as an appendix in a future edition of the present Manual.

3.3.1.7 Members operating regional marine instrument centres should follow the relevant specifications concerning capabilities and corresponding functions.

Note: The Guide to Instruments and Methods of Observation (WMO No. 8), Volume III, Chapter 4, Annex 4.A, specifies capabilities and corresponding functions for operating regional marine instrument centres. This material will be included as an appendix in a future edition of the present Manual.

3.3.2 Requirements for instruments

3.3.2.1 Members shall avoid the use of mercury in their observing systems. Where mercury is still in use, Members shall define and obey appropriate safety precautions.

Note: The Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapter 3, Annex 3.A, provides safety precautions for the use of mercury. This material will be included as an appendix in a future edition of the present Manual.

3.3.2.2 For the inflation of meteorological balloons, Members should prefer helium over hydrogen. **If hydrogen is used, however, Members shall define and obey the appropriate safety precautions.**

Note: The Guide to Instruments and Methods of Observation (WMO No. 8), Volume III, Chapter 8, 8.6, provides safety precautions for the use of hydrogen. This material will be included as an appendix in a future edition of the present Manual.

3.3.2.3 Members shall calibrate all pyrheliometers, other than absolute pyrheliometers, by comparison, using the sun as the source, with a pyrheliometer that is traceable to the World Standard Group and has a likely uncertainty of calibration equal to or better than the pyrheliometer being calibrated.

Note: The Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapter 7, 7.2.1.4, provides detailed guidelines on the calibration of pyrheliometers.

3.3.2.4 Members shall regularly calibrate and ensure traceability of observations from their barometers according to the specified practices.

Note: The Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapter 3, 3.6, highlights the importance of the atmospheric pressure observations and provides relevant guidance.

3.4 OPERATIONS

3.4.1 General requirements

Members operating surface-based observing systems shall follow the provisions of section 2.4.1.

3.4.2 Observing practices

3.4.2.1 Members shall ensure that the exposure, when applicable, of instruments for the same type of observation at different stations is similar so that observations may be compatible.

3.4.2.2 Members shall determine a reference height for each surface observing station or system.

Note: A reference height is defined as follows:

- (a) Elevation of the station: it is the datum level to which barometric pressure reports at the station refer; such current barometric values are termed "station pressure" and are understood to refer to the given level for the purpose of maintaining continuity in the pressure records;
- (b) For stations not located on aerodromes: elevation (height above mean sea level) of the ground on which the rain gauge stands or, if there is no rain gauge, of the ground beneath the thermometer screen. If there is neither rain gauge nor screen, it is the average level of terrain in the immediate vicinity of the station, expressed in metres rounded up to two decimals;
- (c) For stations located on aerodromes it is the official altitude of the aerodrome.

3.4.3 Quality control

Members operating surface-based observing systems shall follow the provisions of section 2.4.3.

3.4.4 Data and metadata reporting

Members operating surface-based observing systems shall follow the provisions of section 2.4.4.

3.4.5 Incident management

Members operating surface-based observing systems shall follow the provisions of section 2.4.5.

3.4.6 Change management

Members should compare observations from new instruments over an extended interval before the old measurement system is taken out of service or when there has been a change of site. Where this procedure is impractical at all sites, Members should carry out comparisons at selected representative sites.

Notes:

- 1. This does not apply to all types of station; among the exceptions are hydrological stations.
- 2. Further details, including the required minimum intervals for such comparison, can be found in the Guide to Climatological Practices (WMO No. 100), 2.6.7.

3.4.7 Maintenance

Observing sites and instruments should be maintained regularly so that the quality of observations does not deteriorate significantly between station inspections.

Note: Detailed guidance on maintenance of observing sites, observing systems and instruments is given in the Guide to Instruments and Methods of Observation (WMO No. 8), Volumes I, III and V, and the Guide to Hydrological Practices (WMO No. 168), Volume I, 2.5.4 and 9.8.4.

3.4.8 Inspection and supervision

3.4.8.1 Members shall arrange for their surface observing sites, stations and systems to be inspected at sufficiently frequent intervals to ensure that a standard of

observations that meets its defined uncertainties is maintained, that instruments and all their indicators are functioning correctly, and that the exposure relevant to the instrument measurements has not changed significantly.

Notes:

1. Detailed guidance on inspection, including frequency, is given in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapter 1, 1.3.5; Volume III, Chapter 1, 1.7; Volume V, Chapter 1, 1.10.1, and Chapter 4, 4.3.4.
2. Reference is made to the Technical Regulations (WMO No. 49), Volume II, for provisions on the inspection of aeronautical meteorological stations including its frequency.

3.4.8.2 Members shall ensure that the inspection is performed by qualified and adequately trained staff.

3.4.8.3 When performing inspections, Members should ensure that:

- (a) The siting, selection and installation, as well as exposure when applicable, of instruments are known, recorded and acceptable;
- (b) Instruments have approved characteristics, are in good order and regularly checked against relevant standards;
- (c) There is uniformity in the methods of observation and in the procedure for any reduction of observations.

Note: Detailed guidance on inspection and supervision of observing systems and sites is given in the Guide to Instruments and Methods of Observation (WMO No. 8), which includes guidelines on GAW measurements (see Volume I, Chapter 16), the Guide to Hydrological Practices (WMO No. 168), Volume I, 2.5.3, 2.5.5, 8.7 and 9.8.4, and the Manual on Stream Gauging (WMO No. 1044), Volume I, 4.4 and 4.8.

3.4.9 Calibration procedures

Members operating surface-based observing systems shall follow the provisions of section 2.4.9.

3.5 OBSERVATIONAL METADATA

Note: Detailed guidance regarding the establishment, maintenance and update of metadata records is given in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapter 1, 1.1.3 and 1.3.4; the Guide to Climatological Practices (WMO No. 100), 2.5 and 2.6.9; the Guide to the Global Observing System (WMO No. 488), Appendix III.3; and the Guide to Hydrological Practices (WMO No. 168), Volume I, Chapter 10.

Members operating surface-based observing systems shall follow the provisions of section 2.5.

Note: Further provisions specific to the WIGOS component observing systems appear in sections 5, 6, 7 and 8.

3.6 QUALITY MANAGEMENT

Members operating surface-based observing systems shall follow the provisions of section 2.6.

Note: Further provisions specific to the WIGOS spacebased subsystem appear in section 4; those specific to the WIGOS component observing systems appear in sections 5, 6, 7 and 8.

3.7 CAPACITY DEVELOPMENT

Members operating surface-based observing systems shall follow the provisions of section 2.7.

Note: Further provisions specific to the WIGOS spacebased subsystem appear in section 4; those specific to the WIGOS component observing systems appear in sections 5, 6, 7 and 8.

APPENDIX 3.1 ~~DESIGNATION PROCESS~~ ASSIGNMENT OF GBON STATIONS/PLATFORMS

The ~~designation process~~ assignment of GBON stations/platforms as specified in the present appendix shall be followed by all stakeholders.

~~Notes: Note: The World Meteorological Congress, at its nineteenth session (Cg-19), did not approve the initial list of GBON stations, but rather requested INFCOM to develop the technical guidelines, processes and procedures needed to ensure the expedient and efficient implementation of GBON, to prepare for the effective performance and compliance monitoring of GBON, and to report to the Executive Council (see Resolution 21 (Cg-19) -- GBON Implementation (World Meteorological Congress: Abridged Final Report of the Nineteenth Session (WMO No. 1326))). The present Appendix will be updated accordingly.~~

1) The composition of GBON is updated according to the proposals of Members with regard to the assignment of GBON stations/platforms in OSCAR/Surface.

2) Members have the authority to assign stations/platforms to GBON, either on the basis of the global gap analysis or one performed by the Member.

3) All marine stations/platforms registered in OSCAR/Surface that report observations of the variables defined in provisions 3.2.2.10 and 3.2.2.15 are considered GBON stations/platforms, due to the short life span and moving nature of many of the observing platforms.

1. The list of GBON stations/platforms is drawn from the list of all available stations/platforms in WIGOS as registered in OSCAR/Surface by the Members, and monitored by the WDQMS for data quality.
2. The ~~identification~~ assignment of the subset ~~to be proposed of Member's stations/platforms by Members for~~ GBON ~~designation~~ is based on sections 3.2.2.7–3.2.2.10 and 3.2.2.12–3.2.2.15.

Note: All marine stations/platforms registered in OSCAR/Surface that report observations of the variables in defined in provisions 3.2.2.10 and 3.2.2.15 are considered GBON stations/platforms.

~~3. The list of GBON stations/platforms is elaborated in collaboration between the Members and INFCOM.~~

~~4.3.~~ INFCOM undertakes a regular analysis of the status of the GBON implementation that provides, for each Member, the number of surface stations/platforms and the number of upper-air stations/platforms that are required for the Member to meet its obligations under 3.2.2.7–3.2.2.10 and 3.2.2.12–3.2.2.15.

~~5.4.~~ For each Member, INFCOM reviews its ~~designated~~ assigned contribution as per 3.2.2.21 and assesses whether it meets the requirements specified in 3.2.2.7–3.2.2.10 and 3.2.2.12–3.2.2.15, and informs the Member in writing of its findings.

~~6.5.~~ ~~For the~~ The maintenance of GBON stations/platforms, the ~~proposed designation~~ new assignment or removal of GBON stations/platforms ~~by Members is~~ made and recorded in OSCAR/Surface by Members' their national focal points for OSCAR/Surface. All ~~designated~~ assigned GBON stations/platforms will then automatically appear on the

dedicated GBON web tool. ~~The stations designated by Members in OSCAR/Surface are recorded with "Pending Approval" status with regard to their GBON affiliation.~~

Notes:

- 1) When removing GBON stations from their networks, Members must ensure that the integrity and quality of GBON are maintained.
- 2) ~~Assignment and removal of the stations as described here do not apply to the surface marine stations/platforms.~~

~~7: The president of INFCOM, assisted by the Secretariat, reviews the proposed designations and prepares the draft resolution to INFCOM on the updated GBON composition and makes it available to all Members three months before the INFCOM session.~~

~~8: Based on the feedback provided by Members, a final version of the draft resolution on the GBON composition is submitted to INFCOM for approval.~~

~~ATTACHMENT 3.1. THE RANGE OF REQUIREMENTS FOR OBSERVATIONS OF THE WMO APPLICATION AREAS~~

~~1. INTRODUCTION~~

~~Note: One of the three components of the Observing Systems Capability Analysis and Review (OSCAR) tool is a database of requirements for observations. This database is a work in progress and must be interpreted with care. At the start of 2022, some requirements still needed to be added and some existing requirements are now outdated and need to be revised. Furthermore, some changes are being made in the list of application areas whose requirements are recorded in OSCAR/Requirements. All OSCAR information provided in this attachment is for illustrative purposes only and must be checked in the latest version of OSCAR available online before further use.~~

~~Requirements of an application area for geophysical variables, in specified vertical layer/s with specified horizontal coverage, are expressed in terms of criteria such as space and time resolution, uncertainty and latency (Appendix 2.3 provides further details).~~

~~Note: The OSCAR/Requirements database represents the uncertainty as 1 σ or 68% confidence interval, which is not in line with international standard practice. The international standard practice is to use 95% confidence interval which is 2 σ for a standard normal distribution. It was adopted by WMO by mutual agreement with the International Bureau of Weights and Measures (BIPM), and was developed by the Joint Committee for Guides in Metrology (JCGM). It is published as Evaluation of Measurement Data Guide to the Expression of Uncertainty in Measurement (JCGM 100, 2008), a document shared by the JCGM member organizations (BIPM, the International Electrotechnical Commission (IEC), the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC), the International Laboratory Accreditation Cooperation (ILAC), the International Organization for Standardization (ISO), the International Union of Pure and Applied Chemistry (IUPAC), the International Union of Pure and Applied Physics (IUPAP) and the International Organization of Legal Metrology (OIML). Further explanation and details on its use in meteorology are provided in the *Guide to Instruments and Methods of Observation* (WMO No. 8), Volume I, Chapter 1, 1.6.~~

~~The recently added new criteria of layer/s quality, coverage quality and relative priority allow for inclusion of details about what would constitute a "threshold" or "breakthrough" level of performance in case the specified domain requirements (vertical layer and horizontal coverage) are not fully met, and enable relative priority ratings within and between the recorded requirements.~~

~~Each of the twenty-eight WMO application areas requires only some of the approximately 340 physical variables and in only some of the domains. A total of about 850 requirements is listed in OSCAR.~~

~~Where multiple WMO application areas require observations of the same physical variable in the same domain, they generally have different performance requirements.~~

Where a WMO application area requires observations of multiple physical variables in the same domain, there are often different required performance levels in horizontal and vertical resolution, observing cycle and timeliness.

The remaining sections of this attachment convey the structure used to describe performance levels, some examples of requirements and an illustration of how the requirements for observing cycle, horizontal resolution, timeliness and uncertainty vary between WMO application areas for a given variable and between variables for a given WMO application area.

2. PERFORMANCE LEVELS

Each requirement from a WMO application area for observation of a physical variable includes a description of the required performance level, using some or all of the eight criteria listed in section 1 of this attachment, as appropriate.

For each criterion, three values are specified, representing respectively the “threshold”, “breakthrough” and “goal” levels of performance. These levels may be described as follows:

- “Threshold” is the minimum requirement to be met to ensure that the observation is useful;
- “Breakthrough” is an intermediate level between “threshold” and “goal” which, if achieved, would result in a significant improvement for the particular application that registered the requirement;
- “Goal” is an ideal requirement above which further improvements are not necessary.

3. EXAMPLES OF REQUIREMENTS^a OF APPLICATION AREAS FOR OBSERVATIONS OF PHYSICAL VARIABLES

The best way to assess the value of an observation is to consider the required level of performance against all eight criteria when observing one variable in one domain for a single application area.

An example is provided in Table 1. For observations of air temperature (at surface) across the global domain to be of any value to the Climate Monitoring^b application area, the threshold level of performance must be achieved across all defined criteria, that is:

- Uncertainty equal to or less than 0.3 K;
- Horizontal resolution equal to or better than 100 km;
- Observing cycle equal to or shorter than 12 hours;
- Timeliness equal to or better than 2 days.

While many stations in the RBON might satisfy the observing cycle and timeliness threshold levels, only those that also satisfy the uncertainty requirement have any usefulness for this application.

Notes:

- a All OSCAR information provided in the present section is for illustrative purposes only and might be obsolete at the time of reading. The most recent information is available online, in OSCAR/Requirements.
- b The names of the application areas are taken from OSCAR/Requirements, apart from Climate Monitoring which replaces Atmospheric Observation Panel for Climate (AOPC).

Table 1. Summary of Requirement #70 from the OSCAR database, which is the requirement of the Climate Monitoring application area for observations of air temperature (at surface) across the global domain.

	<i>Goal</i>	<i>Breakthrough</i>	<i>Threshold</i>
Uncertainty	0.1K	0.15K	0.3K
Stability/decade (if applicable)			
Horizontal Resolution	25km	50km	100km
Vertical Resolution			
Observing Cycle	3h	6h	12h
Timeliness	24h	36h	2d

Another example is provided in Table 2. For observations of atmospheric temperature in the lower troposphere across the global domain to be of any value to the High-resolution NWP application area, the threshold level of performance must be achieved across all defined criteria, that is:

- Uncertainty equal to or less than 3K;
- Horizontal resolution equal to or better than 10km;
- Vertical resolution equal to or better than 1km;
- Observing cycle equal to or shorter than 6hours;
- Timeliness equal to or better than 2hours.

Only those reports of upper air temperature that are repeated at least four times per day have any value for this application area, even if they satisfy the other performance criteria.

Table 2. Summary of Requirement #341 from the OSCAR database, which is the requirement of the High-resolution NWP application area for observations of atmospheric temperature in the lower troposphere across the global domain.

	<i>Goal</i>	<i>Breakthrough</i>	<i>Threshold</i>
Uncertainty	0.5K	1K	3K
Stability/decade (if applicable)			
Horizontal resolution	0.5km	2km	10km
Vertical resolution	0.1km	0.25km	1km
Observing cycle	15min	60min	6h
Timeliness	15min	30min	2h

Further assessment of the value of an observation can be made by considering how many requirements from different application areas it satisfies. The tables in sections 4 and 5 below help to illustrate the spectrum of requirements across different application areas and across different variables.

4. EXAMPLES OF REQUIREMENTS* FOR OBSERVING CYCLE, HORIZONTAL RESOLUTION, TIMELINESS AND UNCERTAINTY, HIGHLIGHTING DIFFERENCES BETWEEN APPLICATION AREAS FOR A GIVEN VARIABLE

Table 3 shows a wide range of observing cycle requirements for surface air temperature across the different application areas. Hourly observations are required to ensure that the threshold requirements of all application areas are satisfied. Hourly observations would also satisfy the

breakthrough requirements of all but the Nowcasting/Very short Range Forecasting (VSRF) application area.

Table 3. Air temperature at surface: observing cycle requirements for different application areas

Variable: Air temperature at surface Domain: Atmosphere, near surface Coverage: Global or global ocean, except for Aeronautical Meteorology (point at the aerodrome)			
<i>Criterion: Observing cycle</i>	<i>Threshold</i>	<i>Required performance level: Breakthrough</i>	<i>Goal</i>
24 hours	Agricultural Meteorology		
12 hours	Global NWP Climate Monitoring ^b	Agricultural Meteorology ^c	
6 hours	High resolution NWP	Global NWP Climate Monitoring	
3 hours	Ocean Applications ^b Aeronautical Meteorology		Climate Monitoring
60 minutes	Nowcasting/VSRF	High resolution NWP Ocean Applications Aeronautical Meteorology	Global NWP Agricultural Meteorology
30 minutes		Nowcasting/VSRF	High resolution NWP Ocean Applications Aeronautical Meteorology
10 minutes			Nowcasting/VSRF

Notes:

- a All OSCAR information provided in the present section is for illustrative purposes only and might be obsolete at the time of reading. The most recent information is available online, in OSCAR/Requirements.
- b The names of the application areas are taken from OSCAR/Requirements, apart from Climate Monitoring which replaces AOPC, and Ocean Applications which is now replaced by the entire Earth System Application Categories (ESACs).
- c Agricultural meteorology breakthrough requirement is recorded as 15 hours.

Table 4 shows that for lower tropospheric wind (horizontal), Aeronautical Meteorology has the most demanding observing cycle requirements. A 10 minute observing cycle (the threshold level) is required for observations to have any value for this application. However, a 3 hour observing cycle would ensure that the observation has some value for all other applications and significant value (breakthrough level of performance) for several applications including Global NWP. A 12 hour observing cycle would be sufficient to provide some value for Global NWP, High resolution NWP and Ocean Applications. A 24 hour or longer observing cycle would have limited value.

Table 4. Lower tropospheric wind (horizontal): observing cycle requirements for different application areas

Variable: Wind (horizontal) Domain: Atmosphere, lower troposphere Coverage: Global			
<i>Criterion: Observing cycle</i>	<i>Threshold</i>	<i>Required performance level: Breakthrough</i>	<i>Goal</i>
24 hours	Ocean Applications ^a		

~~12 hours~~	~~Global NWP High-resolution NWP~~		
~~6 hours~~	~~Climate Monitoring^a~~	~~Global NWP~~	
~~3 hours~~	~~Nowcasting/VSRE~~	~~Climate Monitoring^b Ocean Applications~~	~~Climate Monitoring~~
~~60 minutes~~		~~High-resolution NWP~~	~~Global NWP~~
~~30 minutes~~		~~Nowcasting/VSRE~~	
~~15 minutes~~			~~High-resolution NWP~~
~~10 minutes~~	~~Aeronautical Meteorology~~		
~~5 minutes~~		~~Aeronautical Meteorology^c~~	~~Nowcasting/VSRE Ocean Applications^d Aeronautical Meteorology~~

Notes:

~~a The names of the application areas are taken from OSCAR/Requirements, apart from Climate Monitoring which replaces AOPC, and Ocean Applications which is now replaced by the entire ESACs.~~

~~b Climate monitoring breakthrough requirement is recorded as 4 hours.~~

~~c Aeronautical meteorology breakthrough requirement is recorded as 7 minutes.~~

~~d Ocean applications goal requirement is recorded as 6 minutes.~~

~~Table 5 highlights the importance of uncertainty when observing surface air temperature for Climate Monitoring application, which require at least 0.3 K and ideally 0.1 K uncertainty. Many other applications gain value from observations having uncertainties as large as 2.0 K.~~

~~Table 5. Air temperature at surface: uncertainty requirements for different application areas~~

~~Variable: Air temperature at surface Domain: Atmosphere, near surface Coverage: Global~~			
~~Criterion: Observing cycle~~	~~Threshold~~	~~Required performance level: Breakthrough~~	~~Goal~~
~~2.0 K~~	~~Global NWP High-resolution NWP Nowcasting/VSRE~~		
~~1.0 K~~	~~Ocean Applications^a~~	~~Global NWP~~	
~~0.80 K~~		~~High-resolution NWP~~	
~~0.70 K~~		~~Nowcasting/VSRE~~	
~~0.50 K~~		~~Ocean Applications~~	~~Global NWP High-resolution NWP Nowcasting/VSRE~~
~~0.30 K~~	~~Climate Monitoring^a~~		
~~0.10 K~~		~~Climate Monitoring^b~~	~~Ocean Applications Climate Monitoring~~

Notes:

~~a The names of the application areas are taken from OSCAR/Requirements, apart from Climate Monitoring which replaces AOPC, and Ocean Applications which is now replaced by the entire ESACs.~~

~~b Climate monitoring breakthrough requirement is 0.15 K.~~

Table 6 shows a range of timeliness requirements for surface atmospheric pressure. Observations lose their value most rapidly for aeronautical meteorology, whose threshold level indicates the observation must be available within 30 minutes to have any value and within 10 minutes to have more significant value (the breakthrough level).

Table 6. Atmospheric pressure at surface: timeliness requirements for different application areas

Variable: Atmospheric pressure at surface Domain: Atmosphere, near surface Coverage: Global or Global ocean			
<i>Criterion: Timeliness</i>	<i>Threshold</i>	<i>Required performance level: Breakthrough</i>	<i>Goal</i>
12 hours	Climate Monitoring ^a Ocean Applications-B ^b		
6 hours	Global NWP	Climate Monitoring Ocean Applications-B	
3 hours			Climate Monitoring Ocean Applications-B
2 hours	High-resolution NWP Ocean Applications-A		
60 minutes		Ocean Applications-A	
30 minutes	Aeronautical Meteorology	Global NWP High-resolution NWP	Ocean Applications-A
15 minutes			High-resolution NWP
10 minutes		Aeronautical Meteorology	
5 minutes			Global NWP ^c Aeronautical Meteorology

Notes:

- a The names of the application areas are taken from OSCAR/Requirements, apart from Climate Monitoring which replaces AOPC.
- b The Ocean Application area used to provide two sets of requirements: A: Ocean forecasting (coastal), and B: Maritime safety services, but it is now replaced by the entire ESACs.
- c Global NWP Goal requirement is 6 minutes.

Table 7 highlights the wide range of requirements for the horizontal resolution of lower tropospheric wind (horizontal) observations. The very demanding requirements of High-resolution NWP and Nowcasting/VSRE applications, even at the threshold level, are likely to be satisfied by RBONs only in very limited domains but not in regional or global domains. In this case, the design of RBONs would need to take into account how its surface stations/ platforms could complement the lower tropospheric wind (horizontal) observations from space.

Table 7. Lower tropospheric wind (horizontal): horizontal resolution requirements for different application areas

Variable: Wind (horizontal) Domain: Atmosphere, lower troposphere Coverage: Global			
<i>Criterion: Horizontal resolution</i>	<i>Threshold</i>	<i>Required performance level: Breakthrough</i>	<i>Goal</i>

500 km	Climate Monitoring ^a Global NWP		
200 km	Ocean Applications ^a	Climate Monitoring	
100 km	Aeronautical Meteorology	Global NWP	Climate Monitoring
70 km		Aeronautical Meteorology	
50 km		Ocean Applications	Aeronautical Meteorology
20 km	Nowcasting/VSRE		
15 km			Global NWP
10 km	High-resolution NWP		Ocean Applications
5 km		Nowcasting/VSRE	
2 km		High-resolution NWP	
1 km			Nowcasting/VSRE
0.5 km			High-resolution NWP

^a The names of the application areas are taken from OSCAR/Requirements, apart from Climate Monitoring which replaces AOPC, and Ocean Applications which is now replaced by the entire ESACs.

5. EXAMPLES OF REQUIREMENTS^a FOR OBSERVING CYCLE AND HORIZONTAL RESOLUTION, HIGHLIGHTING DIFFERENCES BETWEEN VARIABLES FOR A GIVEN APPLICATION AREA

Aeronautical Meteorology has specified requirements for observations of 36 physical variables, of which 14 have specified performance requirements for an observing cycle. A representative subset consisting of 8 of those 14 variables is included in Table 8, illustrating the range of different observing cycle requirements for different variables.

Table 8. Aeronautical meteorology: observing cycle requirements for different physical variables

Application area: Aeronautical Meteorology			
<i>Criterion: Observing cycle</i>	<i>Threshold</i>	<i>Required performance level: Breakthrough</i>	<i>Goal</i>
3 hours	Temperature: LT, HT, LS ^b Specific humidity: LT		
2 hours	Atmospheric pressure at surface (sfc) Precipitation type (at sfc)		
90 minutes		Temperature: LT, HT, LS Specific humidity: LT	
60 minutes		Atmospheric pressure (at sfc) Precipitation type (at sfc)	Temperature: LT, HT, LS Specific humidity: LT
30 minutes			Atmospheric pressure (at sfc) Precipitation type (at sfc)
10 minutes			
5 minutes			
2 minutes	Meteorological optical range (at sfc) Wind gust (at sfc) Wind speed (at sfc) Wind vector (at sfc) ^c		

60-seconds		Wind-gust (at sfc) Wind-speed (at sfc) Wind-vector (at sfc)	
30-seconds		Meteorological optical range (at sfc) ^d	
5-seconds		Wind-gust (at sfc) Wind-speed (at sfc) Wind-vector (at sfc)	

Notes:

- a All OSCAR information provided in the present section is for illustrative purposes only and might be obsolete at the time of reading. The most recent information is available online, in OSCAR/Requirements.
- b LT = lower troposphere; HT = higher troposphere; LS = lower stratosphere;
- c The coverage specified for Meteorological optical range (at surface), wind gust (at sfc), wind speed (at sfc) and wind vector (at sfc) is point only at aerodromes, while global coverage is required for the other variables;
- d The requirement for Meteorological optical range (at surface) is actually 108 seconds (threshold) and 36 seconds (breakthrough), while no goal level is specified.

High-resolution NWP has specified requirements for observations of 56 physical variables, all with specified performance requirements for horizontal resolution. A representative subset consisting of 23 of those 56 variables is included in Table 9, illustrating the range of different horizontal resolution requirements for different variables.

Table 9. High-resolution NWP: horizontal resolution requirements for different physical variables

Application area: High-resolution NWP			
<i>Criterion: Horizontal resolution</i>	<i>Threshold</i>	<i>Required performance level: Breakthrough</i>	<i>Goal</i>
100 km	Wind (horizontal): LS ^a Temperature: LS Ozone: LS		
40 km	Wind-vector (at sfc) ^a Atmospheric pressure (at sfc) Ozone (total column) Sea-ice thickness Soil moisture Dominant wave period Leaf Area Index		
30 km	Specific humidity: HT ^a		
25 km	Temperature: HT	Wind (horizontal): LS Temperature: LS	
20 km	Wind (horizontal): HT Wind-speed (at sfc) Temperature (at sfc) Specific humidity: LT ^a Specific humidity (at sfc)	Ozone: LS	
10 km	Wind (horizontal): LT Temperature: LT Precipitation intensity (at sfc) Cloud cover Cloud type	Wind (horizontal): HT Wind-vector (at sfc) Specific humidity: HT Atmospheric pressure (at surface) Ozone (total column)	Wind (horizontal): LS Temperature: LS

		~~Sea-ice thickness~~ ~~Dominant wave period~~	
~~5 km~~	~~Precipitation type (at sfc)~~	~~Wind speed (at sfc)~~ ~~Temperature: HT~~ ~~Temperature (at sfc)~~ ~~Specific humidity: LT~~ ~~Specific humidity (at sfc)~~ ~~Soil moisture~~ ~~Leaf Area Index~~	~~Ozone: LS~~ ~~Dominant wave period~~
~~2 km~~		~~Wind (horizontal): LT~~ ~~Temperature: LT~~ ~~Precipitation intensity (at sfc)~~ ~~Cloud cover~~ ~~Cloud type~~	~~Wind (horizontal): HT~~ ~~Wind vector (at sfc)~~ ~~Specific humidity: HT~~ ~~Atmospheric pressure (at sfc)~~ ~~Ozone (total column)~~ ~~Sea-ice thickness~~
~~1 km~~		~~Precipitation type (at sfc)^b~~	~~Temperature: HT~~ ~~Temperature (at sfc)~~ ~~Specific humidity (at sfc)~~ ~~Soil moisture~~ ~~Leaf Area Index~~
~~0.5 km~~			~~Wind (horizontal): LT~~ ~~Wind speed (at sfc)~~ ~~Temperature: LT~~ ~~Specific humidity: LT~~ ~~Precipitation intensity (at sfc)~~ ~~Cloud cover~~ ~~Cloud type~~
~~0.25 km~~			~~Precipitation type (at sfc)~~

Notes:

a LS = lower stratosphere; LT = lower troposphere; HT = higher troposphere; sfc = surface;

b Precipitation type (at sfc) breakthrough level is 1.5 km.

4. ATTRIBUTES SPECIFIC TO THE SPACEBASED SUBSYSTEM OF WIGOS

4.1 REQUIREMENTS

4.1.1 General

Members shall strive to develop, implement and operate a space-based environmental observing system in support of WMO Programmes as described in the CGMS Baseline document introduced in Attachment 4.1.

Note: The spacebased subsystem of WIGOS is established through dedicated satellites, remotely observing the characteristics of the atmosphere, the earth and the oceans.

4.1.2 Observed variables

This subsystem shall provide quantitative data enabling, independently of or in conjunction with surface-based observations, the determination of variables including but not limited to:

(a) Threedimensional fields of atmospheric temperature and humidity;

- (b) Temperature of sea and land surfaces;
- (c) Wind fields (including ocean surface winds);
- (d) Cloud properties (amount, type, top height, top temperature and water content);
- (e) Radiation balance;
- (f) Precipitation (liquid and frozen);
- (g) Lightning;
- (h) Ozone concentration (total column and vertical profile);
- (i) Greenhouse gas concentration;
- (j) Aerosol concentration and properties;
- (k) Volcanic ash cloud occurrence and concentration;
- (l) Vegetation type and status, and soil moisture;
- (m) Flood and forest fire occurrence;
- (n) Snow and ice properties;
- (o) Ocean colour;
- (p) Wave height, direction and spectra;
- (q) Sea level and surface currents;
- (r) Sea-ice properties;
- (s) Solar activity;
- (t) Space environment (electric and magnetic field, energetic particle flux and electron density).

Note: Information regarding the current capabilities of the spacebased subsystem is available through the OSCAR tool at <https://community.wmo.int/oscar> and <https://community.wmo.int/oscarwmoobservationalrequirementsandcapabilities>.

4.1.3 Observing performance requirements

Satellite operators providing observational data to WIGOS shall strive to meet, to the extent possible, the uncertainty, timeliness, temporal and spatial resolution, and coverage requirements of WIGOS as defined in the WIGOS Information Resource (WIR), based on the Rolling Review of Requirements described in section 2.

Notes:

1. In the present Manual, the term "satellite operators" refers to Members or a coordinated group of Members operating environmental satellites.
2. A coordinated group of Members operating environmental satellites acts jointly to operate one or more satellites through an international space agency such as the European Space Agency or the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT).
3. These requirements are recorded and maintained in the requirements database available at <https://community.wmo.int/oscar> and <https://community.wmo.int/oscarwmoobservationalrequirementsandcapabilities>.

4. This standard practice includes giving due regard to relative priorities between the elements of each requirement, where such priorities are recorded in the WIR.

4.1.4 Global planning

Satellite operators shall cooperate to ensure that a constellation of satellite systems is planned and implemented to guarantee the continuous provision of space-based observations in support of WMO Programmes.

Note: Collaboration is pursued within the Coordination Group for Meteorological Satellites (CGMS), which includes all Members operating spacebased observation systems in support of WMO Programmes.

4.1.5 Continuity

4.1.5.1 Satellite operators working together under the auspices of CGMS or otherwise, should ensure the continuity of operation and sustained data dissemination and distribution services of the operational satellites within the subsystem, through appropriate contingency arrangements and relaunch plans.

4.1.5.2 Satellite operators should strive to maintain space-based assets beyond design lifetime if they provide added observations on an affordable basis.

4.1.6 Overlap

Satellite operators should ensure an adequate period of overlap of new and old satellite systems in order to determine inter-satellite instrumental biases and maintain the homogeneity and consistency of time series observations, unless reliable transfer standards are available.

4.1.7 Interoperability

4.1.7.1 Satellite operators shall achieve the greatest possible interoperability of their different systems.

4.1.7.2 Satellite operators shall make available sufficient technical details about the instruments, data processing, transmissions and dissemination schedules for Members to fully exploit the data.

4.2 DESIGN, PLANNING AND EVOLUTION

Note: The spacebased subsystem is composed of:

- (a) An Earth observation space segment;
- (b) An associated ground segment for data reception, processing, dissemination and stewardship;
- (c) A user segment.

4.2.1 Space segment architecture

Note: The overall architecture of the space segment is described in Attachment 4.1. It is defined and evolves in consultation with CGMS.

It includes:

- (a) A constellation of geostationary satellites;
- (b) A core constellation of sunsynchronous satellites distributed over three separate orbital planes;
- (c) Other operational satellites operated on either sunsynchronous orbits or other appropriate low Earth orbits;

(d) Research and development satellites on appropriate orbits.

4.2.2 Space programme life cycles

Satellite operators shall consider a trade-off between the need for a long series to meet the development cost and the user learning curve, on one hand, and the need to develop a new generation in order to benefit from state-of-the-art technology, on the other hand.

Notes:

1. The development of an operational satellite programme is conducted in several phases including: definition of user requirements, feasibility assessment at system level, preliminary design, detailed design, development and testing of the subsystems, integration of all subsystems, system testing, launch campaign and onorbit commissioning. The overall duration of these development phases is typically of the order of 10 to 15 years.
2. The exploitation phase for an operational programme including a series of recurring satellites is typically of the order of 15 years.

4.3 INSTRUMENTS AND METHODS OF OBSERVATION

Notes:

1. Spacebased observation relies on a wide range of sensor types, for example, active or passive, operating in various spectral ranges, and with various scanning or pointing modes. Information on the principles of Earth observation from space, the different types of spacebased instrument and the derivation of geophysical variables from spacebased measurements can be found in the Guide to Instruments and Methods of Observation (WMONo. 8), Volume IV, Chapter 5.
2. Detailed characteristics of current and planned systems of environmental satellites are available in the satellite module of the OSCAR tool, which is available on line (<https://community.wmo.int/oscar-wmo-observational-requirements-and-capabilities>). It also contains an indication of the main instruments that are relevant for each specific variable observable from space, with their potential performance for the respective variables.

4.3.1 Calibration and traceability

4.3.1.1 Satellite operators shall perform a detailed instrument characterization before launch.

Note: Members must strive to follow the prelaunch instrument characterization guidelines recommended by the Global Spacebased Intercalibration System.

4.3.1.2 After launch, satellite operators shall calibrate all instruments on a routine basis against reference instruments or calibration targets.

Notes:

1. Advantage should be taken of satellite collocation to perform onorbit instrument intercomparison and calibration.
2. Calibration must be done in accordance with methodologies established and documented by the Global Spacebased Intercalibration System and the Committee on Earth Observation Satellites (CEOS) working group on calibration and validation.

4.3.1.3 Satellite operators shall provide calibrated data with complete and traceable estimates of stability and uncertainty that are linked to the International System of Units (SI) standards.

Note: The 2022 GCOS Implementation Plan (GCOS-244) calls for the sustained measurement of key variables from space traceable to reference standards, and recommends conducting and evaluating a satellite climate calibration mission.

4.3.1.4 To ensure traceability to SI standards, satellite operators shall define a range of ground-based reference targets for calibration purposes.

4.4 SPACE SEGMENT IMPLEMENTATION

4.4.1 Operational satellites on Geostationary Earth Orbit

4.4.1.1 Satellite operators should implement an operational constellation of satellites in geostationary orbit as described in Attachment 4.1.

4.4.1.2 Satellite operators shall ensure that the constellation of satellites in geostationary orbit provides full disc imagery at least every 15 minutes and achieves coverage of all longitudes, throughout a field of view between 60°S and 60°N.

Note: This implies the availability of at least six operational geostationary satellites if located at evenly distributed longitudes, with inorbit redundancy.

4.4.1.3 Satellite operators should implement rapid-scan capabilities where feasible and ensure that rapid-scan data are available to Members affected by natural disasters, in particular tropical cyclones and volcanic activity.

4.4.1.4 For the imagery mission in geostationary orbit, satellite operators should ensure an availability rate of rectified and calibrated data of at least 99% as a target.

4.4.1.5 To meet the essential requirements for the continuity of data delivery, satellite operators shall strive to implement contingency plans, involving the use of in-orbit standby flight models and rapid call-up of replacement systems and launches.

4.4.2 Core operational constellation on sunsynchronous low Earth orbits

4.4.2.1 Operators of low Earth orbit (LEO) satellites should implement a core operational constellation of satellites in three regularly distributed sun-synchronous orbits as described in Attachment 4.1.

4.4.2.2 Operators of the core constellation of environmental LEO satellites on three sun-synchronous orbital planes, in early morning, mid-morning and afternoon orbit, shall strive to ensure a high level of robustness to permit the delivery of imagery and sounding data from at least three polar orbiting planes, on not less than 99% of occasions.

Note: This implies provisions for a ground segment, instrument and satellite redundancy, and rapid callup of replacement launches or inorbit spares.

4.4.3 Other capabilities on low Earth orbits

Operators of environmental LEO satellites should implement capabilities in appropriate orbits as described in Attachment 4.1.

4.4.4 Research and development satellites

4.4.4.1 Operators of research and development satellites shall consider providing the following observing capabilities:

(a) Advanced observation of the parameters necessary to progress on the understanding and modelling of the water cycle, the carbon cycle, the energy budget and the chemical processes of the atmosphere;

(b) Pathfinders for future operational missions.

Note: For WMO, the main benefits of research and development satellite missions are:

(a) Support of scientific investigations of atmospheric, oceanic and other environmentrelated processes;

- (b) Testing or demonstration of new or improved sensors and satellite systems in preparation for new generations of operational capabilities to meet WMO observational requirements.

4.4.4.2 Members shall strive to maximize the usefulness of observations from research and development satellites for operational applications. In particular, operators of research and development satellites shall make provisions, where possible, to enable near-real-time data availability to promote the early use of new types of observation for operational applications.

Notes:

1. Although neither longterm continuity of service nor a reliable replacement policy are assured, research and development satellites provide, in many cases, observations of great value for operational use.
2. Although they are not operational systems, research and development satellites have proven to support operational meteorology, oceanography, hydrology and climatology substantially.

4.5 GROUND SEGMENT IMPLEMENTATION

4.5.1 General

4.5.1.1 Satellite operators shall make observational data available to Members through the WMO Information System (WIS) in accordance with the provisions laid out in the Manual on the WMO Information System (WMO-No. 1060). Satellite operators shall inform Members of the means for obtaining these data through catalogue entries and shall provide sufficient metadata to enable meaningful use of the data.

4.5.1.2 Core and recommended satellite data

The data listed in the Attachment 4.2 define the initial core and recommended data as per WMO Unified Data Policy for the International Exchange of Earth System Data in relation to satellite data exchange in order to ensure the performance and quality of NWP output. The core and recommended data will be extended to cover all WMO application areas in the future.

4.5.1.23 Satellite operators shall set up facilities for the reception of remote-sensing data (and data collection system data when relevant) from operational satellites, and for the processing of quality-controlled environmental observation information, with a view to further near-real-time distribution.

4.5.1.34 Satellite operators shall strive to ensure that data from polar-orbiting satellites are acquired on a global basis, without temporal gaps or blind orbits, and that data latency meets WMO timeliness requirements.

4.5.2 Data dissemination

4.5.2.1 Satellite operators shall ensure near-real-time dissemination of data sets, as per the requirements of Members, either by direct broadcast from the satellite, or by other means, such as rebroadcast, via telecommunication satellites.

4.5.2.2 In particular, operators of operational sun-synchronous satellites providing the core meteorological imagery and sounding mission should ensure inclusion of a direct broadcast capability as follows:

- (a) Direct broadcast frequencies, modulations and formats should allow a particular user to acquire data from the satellite with a standardized antenna and signal processing hardware. To the extent possible, the frequency bands allocated to meteorological satellites should be used;
- (b) Direct broadcast should be provided through a high data rate stream, such as the Highresolution Picture Transmission (HRPT) or its subsequent evolution, to provide

meteorological centres with all the data required for numerical weather prediction (NWP), nowcasting and other realtime applications;

- (c) If possible, a low data rate stream should also be provided, such as the Lowrate Picture Transmission (LRPT), to convey an essential volume of data to users with lower connectivity or lowcost receiving stations.

4.5.2.3 Satellite operators shall consider implementing rebroadcast via telecommunication satellites to complement and supplement direct broadcast services and to facilitate access to integrated data streams, including data from different satellites, to non-satellite data and to geophysical data products.

4.5.2.4 Operators of operational geostationary meteorological satellites with rapid-scan capabilities shall strive to provide meteorological centres with data in near-real time as required for nowcasting, NWP and other real-time applications.

4.5.3 Data stewardship

4.5.3.1 Satellite operators shall provide a full description of all processing steps taken in the generation of satellite data products, including algorithms, characteristics and outcomes of validation activities.

4.5.3.2 Satellite operators should provide pre-operational data to users before formal data release.

4.5.3.3 Satellite operators shall preserve long-term raw data records and ancillary data required for their calibration and reprocessing as appropriate, with the necessary traceability information to achieve consistent fundamental climate data records.

4.5.3.4 Satellite operators shall maintain and provide unrestricted access to Level 1B satellite data archives including all relevant metadata pertaining to the location, orbit parameters and calibration procedures used.

Note: The data processing levels are described in the Earth Observing System Data and Information System of the US National Aeronautics and Space Administration (NASA) (<https://earthdata.nasa.gov/collaborate/opensdataservicesandsoftware/datainformationpolicy/datalevels>).

4.5.3.5 Satellite operators shall ensure that their archiving system is capable of providing on-line access to the archive catalogue with a browsing facility, that it provides adequate description of data formats and will allow users to download data.

4.5.4 Data collection systems

4.5.4.1 Satellite operators with a capability to receive data and/or products from data collection platforms (DCP) shall maintain technical and operational coordination under the auspices of CGMS in order to ensure compatibility.

4.5.4.2 Satellite operators shall maintain a number of international DCP channels, which should be identical on all geostationary satellites, to support the operation of mobile platforms moving across all individual geostationary footprints.

4.5.4.3 Satellite operators shall publish details of the technical characteristics and operational procedures of their data-collection missions, including the admission and certification procedures.

4.5.5 The user segment

4.5.5.1 Operators of research and development satellites shall implement capabilities enabling Members to access the data in one of the following ways: by downloading data from the server(s) or by receiving data from a rebroadcasting service or a direct broadcast capability.

4.5.5.2 Members shall endeavour to install and maintain in their territory at least one system enabling access to digital data from both LEO and geostationary operational satellite constellations: either a receiver of rebroadcast service providing the required information in an integrated way, or a combination of dedicated direct readout stations.

4.5.5.3 Where appropriate, Members should strive to utilize fixed or moving DCP systems (for example, to cover data-sparse areas) to take advantage of the data-collection and relay capability of the environmental observation satellites.

4.6 OBSERVATIONAL METADATA

For each space-based system they operate, satellite operators shall record, retain and make available observational metadata in accordance with the provisions of section 2.5.

4.7 QUALITY MANAGEMENT

Satellite operators shall include appropriate quality indicators in the metadata for each dataset, in accordance with the provisions of section 2.6.

4.8 CAPACITY DEVELOPMENT

4.8.1 Centres of excellence

Satellite operators, and other Members having the capability to do so, shall provide support to the education and training of instructors in the use of satellite data and capabilities, at specialized Regional Training Centres or other training institutes designated as centres of excellence in satellite meteorology, in order to build up expertise and facilities at a number of regional growth points.

4.8.2 Training strategy

Satellite operators should focus their assistance, to the extent possible, on one or more of these centres of excellence within their service areas and contribute to the Virtual Laboratory for Education and Training in Satellite Meteorology (VLab).

Note: The aim of the education and training strategy implemented through the virtual laboratory is to systematically improve the use of satellite data applied for WMO application areas, with a focus on meeting the needs of developing countries.

4.8.3 User preparation for new systems

4.8.3.1 In order to facilitate a smooth transition to new satellite capabilities, satellite operators should take steps to prepare users through training, guidance on necessary upgrades of receiving equipment and processing software, and the provision of information and tools to facilitate the development and testing of user applications.

4.8.3.2 Satellite operators should provide information on planned and achieved data timeliness, data format and processing tools availability.

4.8.3.3 In addition to working through the virtual laboratory, Members should, as appropriate, exploit partnerships with organizations providing education and training in environmental satellite applications, depending on their specific needs.

4.8.4 Collaboration between users and satellite operators

4.8.4.1 In order to achieve the most effective utilization of satellite data, Members should pursue close collaboration between users and satellite operators at a regional level.

4.8.4.2 Satellite operators should engage with users and document potential impact on applications when developing new satellite systems, products, or ground systems.

4.8.4.3 Working with their regional association, Members should follow systematic steps to document the regional requirements for satellite data access and exchange.

ATTACHMENT 4.1. BASELINE CONTRIBUTION TO THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

(Adopted at the forty-ninth meeting of the Coordination Group for Meteorological Satellites (CGMS-49), 19-21 May 2021)

1. INTRODUCTION TO THE CGMS BASELINE

The [Coordination Group for Meteorological Satellites \(CGMS\)](#) provides a forum for the exchange of technical information on meteorological and environmental satellite systems as well as research and development missions in support of the World Meteorological Organization's (WMO) Rolling Review of Requirements (RRR), the IOC-UNESCO, and other users. The primary goal of the coordination activities is to support operational monitoring and forecasting of weather, space weather and the climate. CGMS coordinates satellite systems of its members in an end-to-end perspective including, but not limited to protection of on-orbit assets, support to users, and facilitation of shared access to satellite data and products.

1.1 Document purpose

1.1 Purpose of the CGMS Baseline

The "Baseline" constitutes the commitments and plans of CGMS members to provide particular observations and services. CGMS members plan to maintain the capabilities and services described below to support the [Global Observing System](#). This [CGMS Baseline](#) document will remain consistent with the principles of the [Vision for the WMO Integrated Global Observing System in 2040](#) (WMO-No. 1243) (hereafter the "WIGOS Vision"), and the WIGOS Vision serves as important input in the development of CGMS members' plans.

1.2 Reference documents

Table 1. Documents referenced in this attachment

<i>Title</i>	<i>Purpose and revision cycle (incl. links)</i>
CGMS Baseline	(This document) Revised at least every 4 years
CGMS Contingency Plan	Defines guidance and the process for identifying, mitigating, and coping with risks to the continuity of the CGMS Baseline. https://www.cgms-info.org/documents/CGMS-contingency-plan-Aug2019.pdf (Ref. CGMS-46-CGMS-WP-28)

~~CGMS High Level Priority Plan (HLPP)~~	~~4 year rolling plan containing high level priorities for CGMS activities. Aspirational targets for enhancing the CGMS response to the WIGOS Vision are included in the HLPP. Revised annually. https://www.cgms-info.org/documents/CGMS_HIGH_LEVEL_PRIORITY_PLAN.pdf~~
~~WMO Gap Analysis~~	~~Contains the WMO gap analysis of CGMS Baseline against the WIGOS Vision. Document provided to CGMS at least every 4 years. CGMS-49-WMO-WP-13.~~
~~WIGOS Vision~~	~~Contains the overall vision for the complete observing system, based on WMO requirements. See WMO No. 1243 and https://community.wmo.int/vision2040~~

1.3 Scope of the Baseline

The Baseline enumerates the observations and their supporting missions that provide meteorological and environmental data required to support the WMO application areas. Support of this goal requires coordination and cooperation among all CGMS members. In order to ensure efficient allocation of resources and timely cooperation, the capabilities contained herein are considered the aggregate baseline capabilities of all CGMS members.

~~In the development of the scope of the Baseline, the following principles determined which missions were included:~~

- ~~• Commitment by CGMS members to provide a capability;~~
- ~~• Longterm sustained provision of the capability by CGMS members;~~
- ~~• Data from missions are available on a free and unrestricted basis;~~
- ~~• Data can be utilized in operational applications;~~

~~This document takes a holistic approach and therefore includes space-based observations; services, including data collection and direct broadcast; as well as data sharing and distribution.~~

1.4 Evolution of the Baseline

The Baseline ~~will be updated at least every four years~~is reviewed annually to take into account the evolving programmatic plans of CGMS members and the WMO Gap Analysis of the CGMS Baseline against the WIGOS Vision. ~~The process for updating the CGMS Baseline is illustrated in Figure 1 below.~~

~~Following approval of the CGMS Baseline, WMO will include the revised CGMS Baseline in this Manual.~~

~~1.5 Additional response to the WIGOS Vision~~

~~The Baseline constitutes the most comprehensive CGMS response to the WIGOS Vision possible under the current programmatic constraints and specific national priorities. CGMS will continue to strive for a full implementation of the WIGOS Vision and CGMS Working Group III will propose targets for extending the response to the WIGOS Vision. These targets will (after approval by the CGMS plenary) be reflected in the 4 year rolling CGMS High Level Priority Plan, and will be reflected in the CGMS Baseline when realised as fully committed contributions by CGMS members.~~

2. OBSERVATIONS AND ORBITS

The orbits considered by CGMS for exploitation include Low Earth Orbit (LEO), Geostationary Orbit (GEO), Highly Elliptical Orbit (HEO), and at the L1 Lagrange point:

- LEO may be sunsynchronous or drifting. Sunsynchronous orbits may have Equatorial Crossing Time (ECT) in the "early morning" (typically, 5:30 and 17:30), the "midmorning" (typically, 9:30 and 21:30) or the "afternoon" (typically, 13:30 and 1:30). They overfly approximately the same location of the Earth, including high latitudes, at approximately the same time twice/day. For largeswath instruments, coverage at 4hour intervals requires three satellites at fairly spaced ECT's. Drifting orbits with different inclination provide more frequent coverage of lower latitudes and ensure the viewing of the Earth at changing times of the diurnal cycle.
- GEO provides continuous view of about one third of the Earth's surface centred on the stationary subpoint. Full coverage of all longitudes, excluding polar regions, requires a number of evenly spaced satellites.
- HEO can be used for frequent Earth observation of high latitudes, or to fly through the magnetosphere at various distances from the Earth, for the purpose of space weather. [Note that HEO missions are being planned by some CGMS members but are not yet considered part of the CGMS Baseline].
- L1 provides continuous view of the Sun, and in situ detection of particles of the solar wind several minutes before they reach the magnetosphere and the Earth.
- The term SunEarth line used below should be understood as covering observations that may be obtained from any suitable orbital position on the line connecting the Sun and the Earth when monitoring or observing the sun. Typical orbital positions include GEO and the first Lagrangian Point (L1). Requirement for continuous observations needs to be taken into account for orbits around the Earth because of potential satellite eclipses.
- Other orbits away from the SunEarth line (such as L5 or L4) can be used for solar and heliospheric imaging and in situ measurements for space weather to improve the coverage and enhance space weather forecasting.

The observations are a combination of active and passive remotely sensed observations, and in situ measurements.

Table 2. Overview of orbits and observations currently considered by CGMS

Multi-purpose meteorological imagers (multispectral, visible, and IR)	LEO, GEO	Sea surface temperature (SST), aerosols, land surface temperature, cloud properties, feature tracking winds (AMV), flood mapping, fires, cryosphere applications (sea ice, snow cover, etc.), ocean colour	LEO – 3 sun-synchronous orbits, nominally early morning, mid-morning, and afternoon IR dual-angle view imagery for high-accuracy SST (at least one a.m. spacecraft) GEO – 137°W, 75.2°W, 0°, 74°E, 76°E, 82°E, 86.5°E, 105°E, 128.2°E, 140°E

Multi-viewing, multi-channel, multi-polarization imager.	LEO	Aerosol, cloud microphysics, BRDF (Bidirectional Reflectance Distribution Function)	LEO -- 1 sun-synchronous orbit
Lightning mapper	GEO	Lightning mapping	GEO -- 137°W, 75.2°W, 0°, 86.5°E-105°E
Broadband short/long wave radiometer	LEO	Radiation balance	LEO -- 2 sun-synchronous orbits, early morning and afternoon orbit
Visible/UV spectrometer	LEO, GEO	Aerosol, Atmospheric composition: O ₃ , CO ₂ , NO ₂ , SO ₂ , BrO, Cl	LEO -- 2 sun-synchronous orbits mid-morning and afternoon GEO -- 2 slots at 0° and 128.2°E
UV limb spectrometer	LEO	Aerosol, Atmospheric composition: O ₃	LEO -- 2 sun-synchronous orbits, mid-morning, afternoon
SWIR imaging spectrometer	LEO	Atmospheric composition: CO ₂ , CH ₄	LEO -- 2 orbit sun-synchronous late morning or afternoon
Precipitation radar	LEO	Precipitation	LEO -- drifting orbit
Microwave imager	LEO	Sea surface temperature, ocean surface winds, precipitable water, soil moisture, snow and ice properties, sea ice properties, precipitation, cloud liquid water	LEO -- 2 sun-synchronous orbits, nominally mid-morning and afternoon
Narrow band imager	LEO, GEO	Ocean colour, aerosol	LEO -- 2 orbits GEO -- 1 slot, 128.2°E
Radar altimetry	LEO	Ocean surface topography	LEO -- 1 orbit mid-morning as well as reference mission on a high-precision, drifting orbit
Scatterometer	LEO	Ocean surface winds	LEO -- 3 sun-synchronous orbits, early morning, mid-morning and afternoon orbits
Submillimetre ice cloud imager	LEO	Cloud ice	LEO -- sun-synchronous mid-morning orbit
Synthetic aperture radar	LEO	Soil moisture, sea ice	LEO -- 1 orbit
High resolution optical imager	LEO	Land use, vegetation type and status, aerosol	LEO -- 1 orbit

Coronagraph	Sun-Earth line	Coronagraphy	GEO -- 1 slot L1
EUV imager	Sun-Earth line	EUV imagery	GEO -- 2 slots LEO -- 1 orbit
X-Ray spectrograph	Sun-Earth line	X-Ray flux	GEO -- 2 slots L1
Energetic particle sensor	LEO, GEO, L1	Magnetospheric and solar energetic particles	LEO -- 3 orbits GEO -- 137°W, 75.2°W, 0°, 31°E, 86.5°E-105°E, 128.2°E including hosted payload missions L1 as in situ measurement
Magnetometer	GEO, L1	Earth's magnetic field, interplanetary magnetic field	GEO -- 4 slots: 137°W, 75.2°W, 86.5°E-105°E, 128.2°E, in situ measurement L1 as in situ measurement
Plasma Analyser	L1	Solar wind	L1 as in situ measurement

3. SERVICES

3.1 Data sharing services

Meteorological applications in general are critically dependant on global exchange of observation data. The international exchange of satellite data obtained by the CGMS Baseline system is a vital element of the WMO Integrated Global Observing System, which underpins the operational weather, climate, hydrological and other environmental services of all 193 WMO Members. In particular, it provides critical global input data for the WMO Members designated as Global Producing Centres for long- and medium-range weather forecasts, Tropical Cyclone Forecasting Centres and Centres for Transport Modelling for Environmental Emergency Response. CGMS members will establish and operate terrestrial and space-based dissemination services in order to exchange observations directly among members, and to make them available to National Hydrological and Meteorological Services and to the broader international user community in a timely and cost-effective manner. This data exchange should follow CGMS best practices.

3.1.1 Direct broadcast services

The core meteorological satellite systems in LEO orbits, and other operational satellite systems where applicable, should ensure low latency data access of imagery, sounding, and other real time data of interest to users by means of direct broadcast or other mechanisms. Application areas where low latency and availability is suitable include Severe Weather Monitoring, Nowcasting and Short- and Medium-Range Numerical Weather Prediction. Other application areas could also benefit from very low latency products, such as ionospheric monitoring. CGMS members should follow the best practices for direct broadcast services developed by CGMS Working Group I.

3.2 In situ data relay

CGMS members will provide for the relay of in situ meteorological and environmental information from fixed and mobile platforms (such as ocean buoys, tide gauges, tsunami platforms, and river gauges). In situ data relay services should be provided on both LEO and GEO satellites when relevant.

4. ENSURING DATA AND SERVICES

To ensure quality and continuity of observations CGMS members will take the following steps in the provision of their data and services:

4.1 Calibration and validation

CGMS members are responsible for ensuring the quality and compatibility of satellite observations taken at different times and locations, by different instruments, and by various satellite operators. CGMS members will characterize instruments prior to launch, follow the common methodologies, and implement operational procedures outlined by Global Space-based Inter-Calibration System (GSICS). Instruments should be inter-calibrated on a routine basis against reference instruments or calibration sites.

CGMS will strive to achieve global compatibility of satellite products, by establishing commonality in the derivation of satellite products for global users where appropriate and by fostering product validation and inter-satellite comparison through International Science (SCOPE) type mechanisms.

4.2 Contingency planning to ensure continuity

CGMS members will take steps to ensure continuity of this CGMS Baseline by following the guidelines outlined in the CGMS contingency plan.

4.3 Monitoring implementation of the Baseline

CGMS will monitor members' implementation of the CGMS Baseline through an annual risk assessment. CGMS members will provide the information necessary to compare current observing capabilities against the CGMS Baseline. This assessment is outlined in the CGMS global contingency plan.

4.4 Research to operations and employing research missions

The CGMS Baseline focuses on satellite missions that are provided on an operational and sustained basis. This does not preclude the use by CGMS members of other missions undertaken on a research or experimental basis (for example, to demonstrate a specific capability). Research and experimental missions support the CGMS Baseline by:

- Supplementing the CGMS Baseline observations;
- Providing a pathway for new sensors and observations to be added to the CGMS Baseline as future operational missions;
- Supporting contingency operations in the case of a gap in the CGMS Baseline;

4.5 System compatibility and interoperability

In order to help maintain a robust WMO Global Observing System (GOS), CGMS members shall work through CGMS Working Groups I, II and IV to establish and adopt best practices for interoperability and compatibility of systems and services.

FIGURE 1. CGMS BASELINE PROCESS

ATTACHMENT 4.2. CORE AND RECOMMENDED SATELLITE DATA

Note: The data listed here are the initial core and recommended data as per WMO Unified Data Policy for the International Exchange of Earth System Data in relation to satellite data exchange expressed by global NWP centres to ensure the performance and quality of NWP output.

Table x. Core satellite data

Geostationary core constellation with a minimum of five satellites providing complete Earth coverage		
Type of satellite sensors	Products	Attributes
Multi-spectral VIS/IR imager	Level 1: Radiances Level 2: Clear Sky Radiances (CSR), All Sky Radiances (ASR), Atmospheric Motion Vectors (AMVs), Aerosol Optical Depth (AOD), Sea Surface Temperature (SST), Land Surface Temperature (LST)	
Hyperspectral Infrared Sounder	Level 1: Radiances Level 2: AMVs	Level 1: Compressed (PC, BUFR compression or similar) with subset of channels.
Lightning Mapper	Level 2: Lightning flash products	
Sun-synchronous core constellation satellites in three orbital planes (morning, afternoon, early morning)		
Type of satellite sensors	Products	Attributes
VIS/IR imager	Level 1: Radiances Level 2: Aerosol Optical Depth (AOD), Atmospheric Motion Vectors (AMVs), Sea Surface Temperature (SST), Land Surface Temperature (LST)	Including water vapour channels
Hyperspectral Infrared Sounder	Level 1: Radiances	
Microwave Sounder	Level 1: Radiances	
Microwave Imager	Level 1: Radiances Level 2: SST, total column water vapour, clouds, precipitation, soil moisture, sea ice, snow water equivalent	Including low-frequency imager (e.g. L-Band)
Scatterometer	Level 2: Ocean surface wind vectors, soil moisture	
Other Low-Earth orbiting satellites		
Type of satellite sensors	Products	Attributes
Microwave Sounder	Level 1: Radiances	
Microwave Imager	Level 1: Radiances Level 2: SST, total column water vapour, clouds, precipitation, soil moisture, sea ice, snow water equivalent	Including low-frequency imager (e.g. L-Band)
Wide-swath radar altimeter and high altitude, inclined, high-precision orbit altimeter	Level 2: Sea surface height, ocean surface wind speed and significant wave height, ice freeboard	

<u>UV/VIS/NIR sounder, nadir and limb</u>	<u>Level 2: Aerosol properties, O₃, CO, CO₂ and other atmospheric constituents</u>	
<u>IR dual-angle view imagers</u>	<u>Level 2: SST</u>	
<u>Global Navigation Satellite System (GNSS) radio-occultation</u>	<u>Level 1: Bending angle</u> <u>Level 2: Refractivity</u>	<u>Minimum 6000 occultations from low inclination orbits (<30°) distributed geographically and temporally in local time, 1000 occultation from other drifting orbits, and 7600 occultations from sun-synchronous orbits</u>
<u>Absolutely calibrated broadband radiometers and total solar irradiance and solar spectral irradiance radiometers</u>	<u>Level 1: Radiances</u>	

Table x. Recommended satellite data

Geostationary core constellation with a minimum of five satellites providing complete Earth		
<u>Type of satellite sensors</u>	<u>Products</u>	<u>Attributes</u>
<u>Hyperspectral Infrared Sounder</u>	<u>Level 1: Radiances</u>	<u>Full spectrum</u>
Data from Low-Earth orbiting satellites		
<u>Type of satellite sensors</u>	<u>Products</u>	<u>Attributes</u>
<u>Multiangle, multipolarization radiometers</u>	<u>Level 1: Radiances</u> <u>Level 2: Aerosol Optical Depth (AOD)</u>	
<u>Precipitation Radar</u>	<u>Level 1: Backscatter</u> <u>Level 2: Precipitation rate</u>	
<u>SAR imagers</u>	<u>Level 1: Backscatter</u> <u>Level 2: Sea ice, Surface Winds, Wave Spectra, Surface Soil Moisture</u>	
<u>Global Navigation Satellite System (GNSS) radio-occultation</u>	<u>Level 1: Bending angle</u> <u>Level 2: Refractivity</u>	<u>The goal of providing 20,000 occultations per day on a sustained basis.</u>
<u>Scatterometer</u>	<u>Level 1: Backscattering cross-sections</u>	
<u>High-resolution optical imagers</u>	<u>Level 1: Radiances</u>	<u>Resolution of 10-100 meters</u>

5. ATTRIBUTES SPECIFIC TO THE GLOBAL OBSERVING SYSTEM OF THE WORLD WEATHER WATCH

Notes:

1. The provisions of sections 1, 2, 3 and 4 are common to all WIGOS component observing systems including GOS. This section contains additional provisions for standard and recommended practices and procedures related to surfacebased observations for GOS.
2. The implementation of GOS encompasses the use of surface and spacebased meteorological (weather and climate) observations, but does not include hydrological or cryospheric observations or those related to the chemical composition and related physical characteristics of the atmosphere.

5.1 REQUIREMENTS

5.1.1 Members shall ensure that time and frequency of observations meet user observational requirements for timeliness and temporal resolution.

Note: These requirements are specified in the [OSCAR/Requirements](http://www.wmosat.info/oscar/observingrequirements) database (<http://www.wmosat.info/oscar/observingrequirements>) with further details provided in other sections of this Manual.

5.1.2 Members should make and provide real-time observations in areas where special weather phenomena are occurring or are expected to develop.

Note: Specific requirements may arise in special circumstances as described in 2.2.2.3.

5.2 DESIGN, PLANNING AND EVOLUTION

5.2.1 Composition of the Global Observing System of the World Weather Watch

5.2.1.1 Members shall design and plan the meteorological component of their surface-based observing network so as to address the requirements of the WMO application areas associated with the World Weather Watch.

Note: The breadth of activities associated with the World Weather Watch includes climatology, agricultural meteorology, aeronautical meteorology and other WMO application areas, and is increasing over time as meteorological science and operations evolve.

5.2.1.2 Members shall provide surface-based meteorological observations from one or more of the following types of station/platform:

- (a) Surface land stations (see Appendix 5.1);
- (b) Surface marine stations (see Appendix 5.2);
- (c) Upperair stations (see Appendix 5.3);
- (d) Aircraft meteorological stations (see Appendix 5.4);
- (e) Radar wind profiler stations (see Appendix 5.5);
- (f) Weather radar stations (Appendix 5.6).

Notes:

1. Any station may belong to more than one of the above categories (a) to (f).
2. A coastal station makes both surface land and surface marine observations. Hence, it may be considered as belonging to both categories (a) and (b).

5.2.1.3 When operating these types of station, Members shall follow the provisions defined in the appendices to this section.

5.2.1.4 For stations contributing to GCOS networks, Members shall follow the provisions defined in Appendix 5.7.

Note: Stations identified as contributing to GCOS networks are selected from categories (a) to (f) under 5.2.1.2. It is necessary for Members to check which of their stations have been selected for inclusion in GCOS networks. This information may be found on the GCOS web site at <https://gcos.wmo.int/en/networks>.

5.2.2 Principles for observing network design and planning

Members shall take into account global and regional observational requirements when they establish their national observing network.

5.3 INSTRUMENTATION AND METHODS OF OBSERVATION

5.3.1 Members shall reduce the observed atmospheric pressure at a station to mean sea level, except at those stations specified in the Manual on Codes (WMO-No. 306), Volume II, section A.1, 12.1, for each Region (Chapter I – VI) and the Antarctic (Chapter VII).

Note: Detailed guidance on the measurement of atmospheric pressure is given in the [Guide to Instruments and Methods of Observation](#) (WMO No. 8), Volume I, Chapter 3, 3.7.

5.3.2 Members shall ensure that instruments for air temperature and humidity measurements are mounted in such a way that the sensors are at the same height, within 1.25 and 2.0 m above ground.

Notes:

1. Detailed guidance is provided by the Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapters 2 and 4.
2. When considerable snow cover occurs, a greater height is permissible in order to maintain the correct height above the snow surface.

5.3.3 Members shall ensure that the exposure of wind instruments over level, open terrain is 10 m above ground.

Notes:

1. Detailed guidance is available in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapter 5, 5.9.
2. At an aeronautical meteorological station, Members should install the wind instruments in accordance with the Technical Regulations (WMO No. 49), Volume II, Part II, 4.1.1.

5.3.4 Members shall ensure that the averaging period for surface wind observations is ten minutes, except that when the 10-minute period includes a marked discontinuity in the wind direction and/or speed, only observations/measured data after the discontinuity is used for obtaining mean values.

Notes:

1. A marked discontinuity is defined in the [Manual on Codes](#) (WMO No. 306), Volume I.1, 15.5.1 (for aerodrome meteorological observation).
2. In such a case, the time interval is correspondingly reduced.
3. Detailed guidance is provided in the [Guide to Instruments and Methods of Observation](#) (WMO No. 8), Volume I, Chapter 5, and Volume V, Chapter 2.
4. For wind observations at an aeronautical meteorological station, Members should follow the Technical Regulations (WMO No. 49), Volume II, Part I, 4.1 and 4.6.1, and Part II, Appendix 3, 4.1.3.

5.3.5 Member should indicate “calm” when the average wind speed is less than 0.5 m s⁻¹.

Note: In that case, the wind direction is reported as 0.

5.3.6 For all cloud observations, Members shall use the tables of classification, definitions and descriptions of clouds as given in the International Cloud Atlas: Manual on the Observation of Clouds and Other Meteors (WMO-No. 407).

Note: See the Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapter 15, for further details.

5.3.7 Members shall comply with the International Cloud Atlas: Manual on the Observation of Clouds and Other Meteors (WMO-No. 407) when observing and reporting present and past weather.

Note: See the Guide to Instruments and Methods of Observation (WMONo. 8), Volume I, Chapter 14, 14.2, for further details.

APPENDIX 5.1. ATTRIBUTES SPECIFIC TO SURFACE LAND METEOROLOGICAL STATIONS

Note: Guidance on the operation of surface land networks is provided in the Guide to the Global Observing System (WMONo. 488), Part III, 3.2; the [Guide to Instruments and Methods of Observation](#) (WMONo. 8), Volume III, Chapters 1 and 2; the Guide to Climatological Practices (WMONo. 100), Chapter 2; and The 2022 GCOS Implementation Plan (GCOS-244).

5.1.1 Members shall ensure that each station is located so as to provide observations representative of the area in which it is situated.

Note: The size of this area may be different for different applications.

5.1.2 Members shall ensure that the actual time of observation is as close as possible to the reported time of observation.

Notes:

1. In general, the measurement of atmospheric pressure is the most sensitive to the time of observation and is to be made at the reported time. Observations of other variables are made over the 10minute period immediately preceding the reported time.
2. Automated systems can generally match the actual time with the reported time, however, manual observations occur over a period of time, especially when many variables are to be observed.
3. It is desirable to report the time of observation for each observed variable where possible and when accommodated by the reporting code.

5.1.3 Members making synoptic observations at their surface land stations shall observe the meteorological variables listed in Attachment 5.1.

Note: The list shows differences between manual and automatic stations, as well as some variables to be included whenever possible or specified as a regional requirement.

5.1.4 Members making synoptic observations shall do so at least at the main standard times.

5.1.5 Members making synoptic observations should do so at the intermediate standard times and the additional standard times.

Note: The threehour frequency of the intermediate standard times provides value for several application areas, while an hourly frequency of the additional standard times provides further value for many application areas.

5.1.76 Members who include snow depth observations as part of their synoptic observations shall do so at least once per day.

Notes:

1. In this case, the time of the snow depth observations is to be the same each day.
2. When snow is not present, snow depth is to be reported as zero (0 cm) for the entire period during which snow is expected but is not present, as determined by resolutions of regional associations [\(it is also applicable to provision 5.1.7\).](#)

5.1.67 Members who include snow depth observations as part of their synoptic observations should do so at least at the main standard times.

Observations for climate applications

5.1.8 Each Member shall establish and maintain at least one reference climatological station.

5.1.9 Members should ensure that each reference climatological station maintains the specified exposure with long-term stability.

Notes:

1. Exposure requirements are specified in the [Guide to Instruments and Methods of Observation](#) (WMO No. 8), Volume I, 1.1.2, 1.3.3, 1.3.4, and in the Guide to Climatological Practices (WMO No. 100), 2.4.
2. Good exposure allows observations to be made in representative conditions, and longterm stability will support the homogeneity of the series of observations.

5.1.10 Members shall make climate observations at a sufficient number of their surface land stations to address the requirements of climate applications.

5.1.11 Members making climate observations for climate applications shall observe the Essential Climate Variables as specified in Appendix 5.8.

5.1.12 Members making observations for climate applications should ensure that observations are made at fixed times, according to either UTC or Local Mean Time, which remain unchanged throughout the year.

Note: When changing to daylight saving time, also known as summer time, observations shall be made one hour later on the local clock.

5.1.13 Members making observations for climate applications two or more times per day should select times that reflect the significant diurnal variations.

5.1.14 Members should provide [daily and monthly summaries \(DAYCLI and CLIMAT reports\)](#) of observations made at their surface land stations [on a monthly basis, according to the Manual on Codes \(WMO-No. 306\)](#).

~~Notes:~~

~~1. See section 3.2.2 (under development).~~

~~2. Monthly summaries have long been provided as CLIMAT messages, offering on a valuable basic set of climatological information.~~

~~3. The Handbook on CLIMAT and CLIMAT TEMP Reporting (WMO/TD-No. 1188) provides instructions on how to set up reports and bulletins in the CLIMAT (TEMP) (SHIP) codes.~~

~~Notes:~~

~~4.1. DAYCLI and CLIMAT reports are to be transmitted by the fifth day of the month (and no later than the eighth day of the month).~~

~~5.2. CLIMAT reports require quality control not only of the measurements themselves, but also of their message encoding to ensure their accurate transmission to national, regional and world centres. Quality checks should be made on site and at a central facility designed to detect equipment faults at the earliest stage possible.~~

Observations for aeronautical meteorology

5.1.15 Members should make observations for aeronautical meteorology at a sufficient number of their surface land stations to address the requirements of aeronautical meteorology.

5.1.16 Members making observations for aeronautical meteorology shall observe the meteorological variables listed in Attachment 5.1.

Note: In addition to the provisions concerning observations for aeronautical meteorology laid out in this Manual, see the relevant ICAO provisions in the Technical Regulations (WMO No. 49), Volume II, Part I, 4 and 5.

Observations for agricultural meteorology

5.1.17 Members should make observations for agricultural meteorology at a sufficient number of their surface land stations to address the requirements of agricultural meteorology.

5.1.18 Members should locate those stations that support agricultural meteorology at a place that is representative of agricultural and natural conditions in the area concerned.

Note: To comply with their obligations to collect and share metadata regarding stations that support agricultural meteorology, Members can refer to the WIGOS Metadata Standard (WMO No. 1192), Chapter 7, Code Table 401, which includes natural biomass, main agrosystems and crops of the area, types of soil, physical constants and profile of soil.

5.1.19 Members making observations for agricultural meteorology shall observe the meteorological variables listed in Attachment 5.1.

Note: Detailed guidance on observing practices of agricultural meteorological observing systems and instruments is given in the *Guide to Instruments and Methods of Observation* (WMO No. 8), Volume I, Chapters 1, 2, 5, 7, 10 and 11; and Volume III, Chapter 9, and in the *Guide to Agricultural Meteorological Practices* (WMO No. 134), Chapter 2.

Lightning location observations

5.1.20 Members should consider acquiring observations from lightning location systems.

Notes:

1. A detailed description of methods in use is provided in the *Guide to Instruments and Methods of Observation* (WMO No. 8), Volume III, Chapter 6.
2. A surface-based sensor at a single station can detect the occurrence of lightning but cannot be used to locate it on an individual flash basis. A network of stations is needed for accurate lightning location.

5.1.21 Members should ensure that the spacing and number of stations is consistent with the technique used and the desired coverage, detection efficiency and accuracy of location.

Radiation observations

Note: Detailed guidance about radiation observations is given in the *Guide to Instruments and Methods of Observation* (WMO No. 8), Volume I, Chapter 7; guidance on operations is available in the *Guide to the Global Observing System* (WMO No. 488), Part III, 3.9.2.2.

5.1.22 Members should establish at least one principal radiation station in each climatic zone of their territory.

Note: The historical concept of principal and ordinary radiation stations will be replaced in a future edition of this Manual by updated terminology including provisions relating to the Baseline Surface Radiation Network (BSRN).

5.1.23 Members should make radiation observations with spacing not exceeding 100 km.

Note: The user observational requirements for radiation climatology and other applications are specified in the *OSCAR/Requirements* database (see <http://www.wmosat.info/oscar/observingrequirements>). Spacing exceeding 100 km would not satisfy the threshold requirement of any application area.

5.1.24 Members shall make available the metadata of their radiation stations in accordance with the provisions of section 2.5.

Note: Metadata of radiation stations should include the category of the station, details of radiometers in use (type and serial number of each instrument, calibration factors, dates of any significant changes), the exposure of radiometers, including height above ground, details of the horizon of each instrument, and the nature of the surface of the ground.

5.1.25 When commencing radiation observations, Members shall ensure adequate exposure that will not change over time.

5.1.26 Radiation observations should include at least the following:

- (a) Continuous recording of global radiation at the Earth's surface;
- (b) Recording of sunshine duration.

5.1.27 At principal radiation stations, the observing programme should include:

- (a) Continuous recording of global radiation at the Earth's surface and its direct and diffuse components;
- (b) Recording of sunshine duration;
- (c) Regular measurements of net radiation (radiation balance) over natural and crop soil cover (made over a 24-hour period).

5.1.28 Members shall express radiometric measurements in accordance with the World Radiometric Reference.

Notes:

1. The Guide to Instruments and Methods of Observation (WMO-No. 8), Volume I, Chapter 7, 7.1.2.2, and Annex 7.A, provides further details on radiometric measurements.
2. In the near future, an SI standard will be available.

5.1.29 Members who make direct solar radiation observations without continuous recording should do so at least three times per day.

Note: In such circumstances, measurements require that the sun and the sky in the vicinity are free from cloud, and that three observation times provide three different solar heights, one of them being near the maximum.

5.1.30 Members who make long-wave radiation observations without continuous recording should do so every night, at least once soon after the end of the evening civil twilight.

APPENDIX 5.2. ATTRIBUTES SPECIFIC TO SURFACE MARINE STATIONS

Note: Guidance on the operations of surface marine networks is provided in the Guide to the Global Observing System (WMO-No. 488), Part III, 3.2 and 3.6, and in the [Guide to Instruments and Methods of Observation](#) (WMO-No. 8), Volume III, Chapter 4. Other relevant guidance may be found in the Guide to Marine Meteorological Services (WMO-No. 471).

5.2.1 Members should make surface marine observations with spatial density in all marine areas which meets the requirements of WMO application areas.

Notes:

1. Members can achieve this by establishing surface marine stations, both fixed and mobile, in their territorial and international waters.
2. Where possible, Members can also consider the opportunity to make subsurface observations from their surface meteorological stations, for example, from ships.

5.2.2 Members making surface marine observations shall ensure that metadata are updated in accordance with the provisions of 2.5 and are available to the database of the WMO-IOC Joint Centre for Oceanography and Marine Meteorology in situ Observations Programmes Support (OceanOPS).

Notes:

1. The OceanOPS database provides an interface to the WIGOS Information Resource – [OSCAR/Surface](#).
2. In the case of ship observations, relevant metadata include also the name, call sign and route or route designator of each ship.

5.2.3 Members making surface marine observations should establish as many sea stations as possible in data-sparse areas and areas of particular interest for WMO application areas.

Note: This may be achieved by recruiting ships and deploying drifting buoys in such areas, and by giving consideration to fixed or moored platforms wherever possible.

5.2.4 Members operating stations on fixed structures and/or moored buoys should ensure that their location provides observations representative of the area in which stations are situated.

5.2.5 Members making surface marine observations shall include as many meteorological variables as possible among those listed in Attachment 5.1.

5.2.6 Members making surface marine observations shall do so at least at the main standard times.

5.2.7 Members making surface marine observations should do so at the intermediate standard times and the additional standard times.

Note: Achieving the threehour frequency of the intermediate standard times provides value for several application areas, while achieving an hourly frequency of the additional standard times provides further value for many application areas.

5.2.8 When operational difficulties on board ship make a surface marine observation impracticable at a main standard time, the actual time of observation should be as near as possible to the main standard time.

5.2.9 Whenever storm conditions threaten or prevail, or other sudden and dangerous weather and marine developments are encountered, surface marine observations should be made and reported as soon as possible and more frequently than at the main standard times.

Notes:

1. Storm conditions refer to the Beaufort scale number 10 and higher.
2. Some observing stations/platforms are better than others for making such adhoc observations.

5.2.10 Members shall report and make available surface marine observations in real time.

Note: Logistics of communications from remote areas may prevent this in certain circumstances.

5.2.11 Members should report and make available surface marine observations also in non-real-time through the Marine Climate Data System, appropriate Data Acquisition Centres and Global Data Assembly Centres.

Notes:

1. The Marine Climate Data System (MCDS) aims to standardize the data system and facilitate access to observations for climate studies and monitoring in accordance with the GCOS climate monitoring principles (Appendix 2.2) and is defined in the Manual on Marine Meteorological Services (WMO No. 558), Volume I, Part VII.
2. Further guidance and information on the structure and different centres within the MCDS can be found in the Guide to Marine Meteorological Services (WMO No. 471), Section 9.3.

Sea-level observations

5.2.12 Members should establish a network of sea-level observing stations along their coasts.

Notes:

1. The design of such networks will consider the requirements of WMO and their partners, and will address topics including storm surges, tsunamis, tidal observations and predictions, and climate trends.
2. Guidance can be found in the Manual on Sealevel Measurement and Interpretation, IOC Manuals and Guides No. 14, Volume IV, (WMO/TDNo. 1339; JCOMM Technical Report No. 31), and the Manual on Sealevel Measurements and Interpretation, IOC Manuals and Guides No. 14, Volume V: Radar Gauges (JCOMM Technical Report No. 89).

5.2.13 Members should make sea-level observations at the main standard times and, in extreme circumstances, as soon as possible and more frequently.

Note: Extreme circumstances may include tsunamis and storm surges.

Research and special-purpose vessel stations

5.2.14 Members operating research and special-purpose vessels should ensure that all such vessels are recruited to be WIGOS stations/platforms.

Note: Such vessels may provide valuable observations and are to be encouraged to provide as many meteorological surface and upperair observations as possible, and subsurface observations down to the thermocline and below, in accordance with the procedures agreed between WMO and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization.

APPENDIX 5.3. ATTRIBUTES SPECIFIC TO UPPERAIR STATIONS

Note: Guidance is provided in the Guide to the Global Observing System (WMO No. 488), Part III, 3.3, and in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapters 12 and 13.

5.3.1 Members should establish a network of upper-air stations/platforms.

5.3.2 Members making upper-air observations should observe as many as possible of the meteorological variables listed in Attachment 5.1.

5.3.3 Members should make upper-air synoptic observations from at least some of their upper-air stations.

Note: Collections of standard sets of variables at standard times have long been referred to as synoptic observations. Upperair synoptic observations have in the past been made by radiosonde systems and other balloonborne systems. Upperair networks now also make extensive use of other systems.

5.3.4 An upper-air synoptic observation shall include a vertical profile of one or more of the following variables:

(a) Wind direction and speed;

(b) Air temperature;

(c) Humidity;

(d) Atmospheric pressure.

Notes:

1. In general, profiles with a high vertical resolution provide greater value for users. Requirements for vertical resolution are documented in the [OSCAR/Requirements](#) database and are described separately for the lower troposphere, high troposphere and lower stratosphere.

2. In general, profiles of all the above variables provide greater value than profiles of a single variable. In particular, radiosonde profiles are highly valued.
3. In the tropics, priority is to be given to upperair wind profile observations.
4. While atmospheric pressure has, in the past, been used as an altitude coordinate, it may also be useful for nonhydrostatic applications.

5.3.5 An upper-air synoptic observation shall include the altitude of each observation in the profile.

Note: Different technologies use different methods to determine altitude. Modern Global Navigation Satellite Systems enable an accurate determination of altitude; however, it remains desirable for radiosondes to also report atmospheric pressure.

5.3.6 An upper-air synoptic observation should include accurate time and horizontal location of each observation in the profile.

5.3.7 Upper-air synoptic observations should be made and reported at the main standard times.

5.3.8 Upper-air synoptic observations shall be made and reported at least at 0000 and 1200 UTC.

5.3.9 For Members using balloon-tracking systems, the balloon release time should be such that the nominal time of the profile observation is near the midpoint of the flight.

Note: Although a balloon flight extends over a period generally exceeding one hour, the resulting profile observation is characterized by a name such as "0000 UTC flight" or "1200 UTC flight". This is the nominal time of the profile observation, however, the balloon release time will be 30 to 45 minutes before the nominal time, or even longer if the balloon is expected to continue ascending to greater heights.

5.3.10 Members should consider equipping suitable ships to provide upper-air synoptic observations.

Other remote-sensing profiler stations

5.3.11 Members should consider the establishment of other remote-sensing profilers.

Note: In addition to the radar wind profiler, addressed in Appendix 5.5, a range of other remotesensing technologies is being used to collect wind and thermal profiles of the atmosphere. The Guide to Instruments and Methods of Observation (WMONo. 8), Volume III, Chapter 5, 5.2, provides further information about acoustic sounders (sodars), radioacoustic sounding systems, microwave radiometers, laser radars (lidars) and the global navigation satellite system. Doppler weather radars may also be used to derive wind profiles.

Planetary boundary-layer observations

5.3.12 Members should establish stations for making observations in the planetary boundary layer.

Notes:

1. These observations are profiles of air temperature, humidity, atmospheric pressure and wind in the lowest 1 500 m of the atmosphere.
2. This information is required in the study of diffusion of atmospheric pollution, the transmission of electromagnetic signals, the relation between freeair variables and boundarylayer variables, severe storms, cloud physics, convective dynamics, and the like.
3. Some of the vertical and horizontal sounding systems that could be applied to specific problems for limited periods in a variety of locations are described in the Guide to the Global Observing System (WMONo. 488), Part III, 3.9.2.7, and in the [Guide to Instruments and Methods of Observation](#) (WMONo. 8), Volume III, Chapter 5.

APPENDIX 5.4. ATTRIBUTES SPECIFIC TO AIRCRAFT METEOROLOGICAL STATIONS

Notes:

1. In addition to the provisions for aircraftbased observations laid out in this Manual, see the relevant ICAO provisions for observations from aircraft in Technical Regulations (WMONo. 49), Volume II, Part I, 5.
2. Guidance on the operations of aircraft meteorological stations is provided in the Guide to the Global Observing System (WMONo. 488), Part III, 3.4, and in the *Guide to Instruments and Methods of Observation* (WMONo. 8), Volume III, Chapter 3.
3. Guidance on the development and operation of the Aircraft Meteorological Data Relay (AMDAR) programme is provided in the Guide to Aircraftbased Observations (WMONo. 1200).
4. More details and further requirements concerning measurement and data processing are available in the *AMDAR Onboard Software Functional Requirements Specification* (Instruments and Observing Methods, Report No. 115, Chapter 3). This publication also provides the standard for the meteorological functionality of AMDAR software applications and airground data formats.
5. Some relevant specifications and guidance can be found in the *ARINC 6208 Data Link Ground System Standard and Interface Specification* (DGSS/IS), which provides specifications of the meteorological report.

5.4.1 Members should arrange for meteorological observations to be made by aircraft of their registry operating on national air routes, and for the recording and reporting of these observations.

Note: These aircraftbased observations can make a significant contribution to the requirements of WMO application areas, particularly if they are made day and night with adequate distribution in space and time.

5.4.2 Members should collaborate with their civil aviation authorities regarding compliance with ICAO requirements for the provision of aircraft reports in support of international air navigation.

Note: Such requirements include the forwarding of aircraft reports by civil aviation authorities to ICAO World Area Forecast Centres (WAFCs) on the aviation telecommunications network so that they can subsequently be made available to WMO Members on the WMO Information System (WIS).

5.4.3 Members should participate in the WMO AMDAR observing system.

5.4.4 Members operating AMDAR observing systems shall provide measurement of air temperature, wind speed, wind direction, pressure altitude, latitude, longitude and time of observation.

5.4.5 Members who operate AMDAR observing systems should include measurement of humidity or water vapour, turbulence, icing and geometric altitude as additional components of AMDAR observations.

Notes:

1. Turbulence: mean, peak and eventbased Eddy Dissipation Rate (EDR) – desirable
2. Turbulence: derived equivalent vertical gust (DEVG) – optional

5.4.6 Members making aircraft-based observations available to the WIS shall have the authorization to do so from the observational data owner.

Notes:

1. The Guide to Aircraftbased Observations (WMONo. 1200), Appendices A and B, provides detailed information on quality control and monitoring of aircraftbased observations.
2. The WMO lead centre on aircraft data undertakes quality monitoring of aircraftbased observations and makes monitoring information available to members at <https://community.wmo.int/activityareas/aircraftbasedobservations/data/monitoring>.

5.4.7 Members operating AMDAR observing systems shall ensure that on-board data quality control is applied in accordance with WMO specifications.

Note: The Guide to Aircraftbased Observations (WMONo. 1200), 1.8 and Appendix A, provides further details.

5.4.8 Members who receive and process aircraft-based observations from any source, including AMDAR and other aircraft-based observing systems, shall make such data available through the WIS in accordance with WMO specifications.

Note: Members need to be aware of specific requirements for handling ICAOrelated observations, which are explained in the Guide to Aircraftbased Observations (WMONo. 1200). Guidance on the encoding and provision of aircraftbased observations to the WIS can also be found there.

5.4.9 Members who receive, process and make available to the WIS aircraft-based observations from any source shall record, retain and make available observational metadata in accordance with the provisions of section 2.5.

Note: The Guide to Aircraftbased Observations (WMONo. 1200), section 1.10 and Appendix D, provides further details. Relevant metadata include those relating to the following aspects and elements of the observational data:

- (a) Models and types of aircraft;
- (b) When and where possible, onboard sensors and their siting, calibration and operational issues and faults;
- (c) Specific software and algorithms used to process data to generate the reported variables;
- (d) Metadata related to quality control processes, data communication practices, data processing and delivering centres.

5.4.10 Members should report disruptions in the normal quality or availability of observations to the relevant WMO global or regional Aircraft Based Observation (ABO) lead centre and to WMO Focal Points ~~en~~for Aircraft-based Observations.

Note: The Guide to Aircraftbased Observations (WMONo. 1200) provides further details. See also 2.4.5 of this Manual.

5.4.11 Members making aircraft-based observations internationally available shall develop procedures for the detection, communication and timely rectification of issues and incidents that adversely affect the quality of observations.

5.4.12 Members who receive and process aircraft-based observations from any source, including AMDAR, ICAO and other aircraft-based observing systems, shall make such observations available to the WIS.

5.4.13 Members who receive, process and make available to the WIS aircraft-based observations from any source, shall make observational metadata available in accordance with the provisions of section 2.5.

APPENDIX 5.5. ATTRIBUTES SPECIFIC TO RADAR WIND PROFILER STATIONS

Notes:

1. Wind profiler observations can be provided by an additional range of remotesensing systems other than radar wind profilers, such as Doppler lidars, Doppler sodars and Doppler weather radars.
2. Generic description of surfacebased remotesensing profiling techniques and systems is provided in the Guide to Instruments and Methods of Observation (WMONo. 8), Volume III, Chapter 5, 5.2; for radar wind profilers in particular see 5.2.2; guidance on operations is available in the Guide to the Global Observing System (WMONo. 488), Part III, 3.9.

5.5.1 Members should consider the establishment of radar wind profiler (RWP) stations in their network of upper-air stations.

~~5.5.2 Members operating RWPs shall comply with national regulations for the use of radio frequencies.~~

Notes:

- ~~1. Extensive information about the use of radio frequencies can be found in the Handbook on Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction (WMONo. 1197).~~
- ~~2. Resolution 217 of the World Radiocommunication Conference 1997 (WRC97) is the basis for frequency allocation for RWPs.~~
- ~~3. Further information is provided in the Guide to Participation in Radiofrequency Coordination (WMONo. 1159).~~
- ~~4. Physical constraints in selecting systems are described in the Guide to Instruments and Methods of Observation (WMONo. 8), Volume III, Chapter 5, 5.2.2. The vertical range of a RWP is strongly related to the operating frequency.~~

5.5.32 Members operating RWPs shall make horizontal wind vector observations.

5.5.43 Members operating RWPs should make vertical wind component observations.

5.5.54 Members shall operate their RWPs continuously so as to acquire and provide horizontal winds at time intervals not exceeding 60 minutes.

Note: Data acquisition at shorter time intervals, for example, every five or ten minutes, may be preferable or required depending on the user requirements and applications that the observations are intended to support. Users must then be cautious about a potential degradation of data quality under certain atmospheric conditions.

5.5.65 Members who exchange RWP observations internationally shall report, as quickly as possible, any major incidents they detect to international recipients of observations, and shall report when such incidents have been resolved, in accordance with the incident management systems under WIGOS.

Notes:

1. A major incident is one that may cause an extended period without observations or with a compromised quality of observations, for example, greater uncertainty or a reduced vertical extent of observations.
2. Some incidents, such as those related to internal factors, may be detected automatically and should be reported without delay to international recipients of observations. Other incidents may be detected with delay or through periodic checks and should be reported accordingly. Automatic incident detection can be performed using either builtin test equipment or external monitoring systems. A centralized system can be used for monitoring the performance and health of RWP systems and networks.
3. It is important to take corrective action in response to incidents, including analysis and recording of the event, as soon as possible.

5.5.76 Members who exchange RWP observations should record and report details of corrective and preventive maintenance in accordance with the provisions of section 2.5.

5.5.87 Members who exchange RWP observations shall record and report inspection results in accordance with the provisions of section 2.5.

5.5.98 Members who exchange RWP observations shall record and report details of calibrations in accordance with the provisions of section 2.5.

Note: Relevant calibration details, in the case of the spaced antenna method of wind determination, include application of the statistical bias correction.

APPENDIX 5.6. ATTRIBUTES SPECIFIC TO WEATHER RADAR STATIONS

Note: A general description of weather radars is given in the *Guide to Instruments and Methods of Observation* (WMO No. 8), Volume III, Chapter 7; guidance on operations is available in the Guide to the Global Observing System (WMO No. 488), Part III, 3.9.2.1.

5.6.1 Members should establish a network of weather radar stations either nationally or in collaboration with other Members.

Note: The requirement for an exchange of weather radar observations is increasing amongst WMO Members to support information such as composite images.

~~5.6.2 Members operating weather radars shall comply with national regulations for the use of radio frequencies.~~

~~Note: Extensive information about the use of radio frequencies is provided in the Handbook on Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction (WMO No. 1197) and also in the Guide to Participation in Radiofrequency Coordination (WMO No. 1159).~~

5.6.32 Members operating weather radars shall operate radars capable of transmitting and receiving horizontally polarized signals.

5.6.43 Members should operate weather radars capable of transmitting and receiving both horizontally and vertically polarized signals.

Note: Such radars are generally known as dualpolarization or polarimetric radars.

5.6.54 Members shall ensure that their weather radars provide observations of the radar reflectivity factor.

5.6.65 Members should ensure that their single-polarization weather radars provide the following observations:

- (a) Radial velocity;
- (b) Spectral width.

5.6.76 Members should ensure that their weather radars with dual-polarization capability provide the following observations:

- (a) Differential reflectivity;
- (b) Crosspolar correlation;
- (c) Differential phase;
- (d) Specific differential phase.

Notes:

1. Further information about the observations made by weather radars is provided in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume III, Chapter 7, Tables 7.1, 7.2 and 7.4.
2. Weather radar operations may pose safety hazards to operators and maintenance personnel as well as to the surrounding community, so the requirement to ensure proper safety procedures is particularly relevant. Typically, onsite safety hazards for weather radars include high voltage, radiation exposure, working in confined spaces, heavy lifting, moving components, climbing and working at heights. Further information is available in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume III, Chapter 7, 7.8.1.

5.6.87 Members who operate weather radars should make observations available at least every 15 minutes.

Notes:

1. It is recognized that there may be seasonal differences in the operation of weather radars in Members' territories. The above recommended reporting frequency applies during periods when the radar is in operation.
2. Requirements to make available metadata related to all observations, including weather radar observations, can be found in section 2.5.

5.6.98 Members operating weather radars shall ensure that their observations are quality assured.

Notes:

1. Refer to the provisions in sections 2.4.3 and 2.6.
2. With regard to weather radars, quality control procedures will improve both qualitative and particularly quantitative uses of weather radar observations.
3. To the extent possible, procedures are to include (a) quality control of both internal and external factors in order to enable the characterization of data quality, and (b) a record of the quality control methods used, to be provided to recipients together with the relevant observations. Further information is available in the Guide to Instruments and Methods of Observation (WMO No. 8), Volume III, Chapter 7, 7.9.

5.6.109 Members operating weather radars should make weather radar observations available for international exchange.

Note: A standard WMO data format is under development. It will ensure that realtime weather radar observations and metadata can be represented and exchanged in accordance with user requirements.

5.6.1110 Members who exchange observations shall provide frequently changing metadata in real time together with the observations, in accordance with the provisions of section 2.5.

Note: Such metadata include information on calibration, timing, beam pointing and other system settings.

5.6.1211 Members who exchange weather radar observations shall provide infrequently changing observational metadata, in accordance with the provisions of section 2.5, to the WMO Radar Database.

Note: Members are strongly urged to provide the infrequently changing observational metadata to the WMO Radar Database (<https://community.wmo.int/maintainingwigosweatherradarmetadata>) for all their weather radars, including those whose observations are not exchanged.

5.6.1312 Members who exchange weather radar observations internationally shall report any major incidents they detect to international recipients of observations, and shall state when such incidents have been resolved, in accordance with the incident management systems under WIGOS.

Notes:

1. A major incident is one which may cause an extended period without observations or with a compromised quality of observations, for example, greater uncertainty or a reduced vertical extent of observations.
2. Some incidents, such as those related to internal factors, may be detected automatically and should be reported without delay to international recipients of observations. Other incidents may be detected with delay or through periodic checks and should be reported accordingly. Automatic detection is facilitated through the use of builtin test equipment and/or external monitoring systems.

5.6.1413 Members should secure their radar coverage by preventing the construction or growth of blockages.

Note: Radar exposure may be compromised, causing reduced coverage, by objects over a wide area, hence negotiations and legal agreements may be required with a range of stakeholders. This is best achieved when establishing a new radar station.

5.6.1514 Members who exchange weather radar observations shall record and report details of corrective and preventive maintenance in accordance with the provisions of section 2.5.

5.6.1615 Members who exchange weather radar observations shall record and report inspection results in accordance with the provisions of section 2.5.

5.6.1716 Members who exchange weather radar observations shall record and report details of calibrations in accordance with the provisions of section 2.5.

Note: Relevant details include calibration variables and their settings or levels, and the terms of the weather radar equation along with the calibration constant.

APPENDIX 5.7. ATTRIBUTES SPECIFIC TO STATIONS CONTRIBUTING TO THE GLOBAL CLIMATE OBSERVING SYSTEM

5.7.1 Members should establish stations as part of Global Climate Observing System (GCOS) Surface Network (GSN) and the GCOS Upper-Air Network (GUAN), in consultation with the GCOS Secretariat.

Notes:

1. Details are available in the Guide to the GCOS Surface Network (GSN) and GCOS UpperAir Network (GUAN) (GCOS144; WMO/TD No. 1558).
2. Attention needs to be given to dataspars areas.
3. The GCOS UpperAir Network is a subset of the upperair network described in Appendix 5.3.

5.7.2 Members should also establish and sustain the GCOS Reference Upper-air Network (GRUAN) to provide long-term high-quality climate records.

5.7.3 In implementing the observing programme at GSN and GUAN stations, Members should adhere to the GCOS Climate Monitoring Principles in accordance with 2.2.2.2.

5.7.4 When operating GUAN stations, Members should adhere to the following practices:

- (a) The reach of soundings should be as high as possible, noting the GCOS requirement for ascents up to a minimum height of 30 hPa, while aiming for 5 hPa where feasible;
- (b) In the event of failure, an immediate repeat release is made in order to meet the GUAN requirement for soundings on at least 25 days in each month;
- (c) Radiosonde sensors are checked in a controlled environment immediately before use.

Note: The Guide to Instruments and Methods of Observation (WMO No. 8), Volume I, Chapter 12, 12.7, provides further details.

GCOS Reference Upperair Network stations

Note: The practices required of GRUAN sites, as detailed in the *GCOS Reference Upperair Network (GRUAN): Manual* (GCOS170, WIGOS Technical Report No. 201302), reflect the primary goal of GRUAN: providing reference-quality observations of the atmospheric column while accommodating the diverse capabilities of sites within the network. However, certification of measurement programmes at a GRUAN site goes beyond considering the extent to which the site adheres to the mandatory practices outlined in the GRUAN Manual, and considers the added value that the site brings to the network. The added value is assessed by experts forming the Working Group on the GCOS Reference Upperair Network, whose judgement is guided by considerations 8.17 to 8.26 (*GCOS Reference Upperair Network (GRUAN): Manual* (GCOS170, WIGOS Technical Report No. 201302), Chapter 8). The GRUAN Manual is supplemented by a more detailed *GCOS Reference Upperair Network (GRUAN): Guide* (GCOS171, WIGOS Technical Report No. 201303), which provides guidelines on how the protocols detailed in the GRUAN Manual might be achieved, and by a series of technical documents available from the GRUAN website at <https://www.gruan.org>

5.7.5 Members with certified GRUAN stations shall follow the practices and procedures as detailed in the *GCOS Reference Upper-air Network (GRUAN): Manual (GCOS-170, WIGOS Technical Report No. 2013-02)*.

5.7.6 Stations contributing to GRUAN shall undergo the GRUAN site assessment and certification process.

5.7.7 Stations within GRUAN shall collect and archive sufficient raw data and metadata to enable the processing, and future reprocessing, of measurements, at a centralized processing facility, into a reference measurement.

Note: As a minimum, GRUAN station metadata include the entire measurement procedure, the uncertainty of the measurement and how it is tied to an internationally accepted traceable standard.

5.7.8 Members shall ensure the long-term homogeneity of measurement series at GRUAN stations.

5.7.9 Members shall operate their GRUAN stations in such a way as to ensure the homogeneity of measurements across the GRUAN network.

5.7.10 Members shall ensure that their GRUAN sites perform pre-launch ground checks for balloon-borne systems.

Note: Other instruments that provide vertical profiles extending from the surface require regular checks to assure correct operation.

5.7.11 Members shall ensure that GRUAN sites provide high-quality parallel measurements to validate the derivation of the measurement uncertainty.

Note: The *GCOS Reference Upperair Network (GRUAN): Manual* (GCOS170, WIGOS Technical Report No. 201302) and the *GCOS Reference Upperair Network (GRUAN): Guide* (GCOS171, WIGOS Technical Report No. 201303) provide detailed instructions and guidance.

APPENDIX 5.8. ATTRIBUTES SPECIFIC TO OBSERVATIONS OF ESSENTIAL CLIMATE VARIABLES

Notes:

1. These Essential Climate Variables (ECVs) were identified by the Commission for Climatology and by the Global Climate Observing System (GCOS); details are provided in The 2022 GCOS ECVs Requirements (GCOS-245), which describes the parameters to be measured for each ECV.
2. See also 2.2.2.2 Climate monitoring principles of the Global Climate Observing System in section 2.
3. Requirements for the ECVs are provided by the RRR process for the application areas which relate to climate monitoring in each of the Earth System Application Categories. Appendix 2.3 provides further details on the RRR process.
4. For climate purposes longterm timeseries are needed in a timely manner.

5.8.1 Members making observations for climate applications shall observe the following mandatory ECVs:

- (a) Surface observations: atmospheric pressure, air temperature, humidity (water vapour), surface wind speed and direction, and precipitation;**
- (b) Upperair observations: air temperature, humidity (water vapour) and wind speed and direction.**

Note: Details on the observation of these ECVs are given in Appendices 5.15.6.

5.8.2 Members shall exchange both historic data archives and current observations of the mandatory ECVs with a tentative maximum delay of one year.

5.8.3 Members making observations for climate applications should observe some or all of the following ECVs.

- (a) Surface land observations: surface radiation budget, clouds, lightning, snow;
- (b) Surface marine observations: seasurface temperature, sea level, sea state, oceansurface heat flux, sea ice;
- (c) Observations made by the observing component of the Global Atmospheric Watch: carbon dioxide, methane and other greenhouse gases, ozone, precursors (supporting the aerosol and ozone ECVs), aerosol properties;
- (d) Observations made by the WMO Hydrological Observing System: river discharge, lakes;
- (e) Observations made by the observing component of the Global Cryosphere Watch: glaciers, ice sheets and ice shelves, permafrost, snow, sea ice.

Note: Details on the observation of these ECVs are given in Appendices 5.1–5.6., and Chapters 6, 7 and 8.

5.8.4 Members should exchange both historic data archives and current observations of the ECVs listed in 5.8.3 with a tentative maximum delay of one year.

5.8.5 Members making observations for climate applications should observe the following remaining ECVs, if feasible.

- (a) Atmospheric observations: Earth radiation budget;
- (b) Ocean observations: subsurface temperature, sea-surface salinity, subsurface salinity, surface currents, subsurface currents, surface stress, oxygen, nutrients, inorganic carbon, transient tracers, nitrous oxide, ocean colour, plankton, marine habitat properties;
- (c) Terrestrial observations: groundwater, Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), leaf area index, albedo, landsurface temperature, aboveground biomass, land cover, soil carbon, fire, anthropogenic greenhousegas fluxes, latent and sensible heat fluxes.

5.8.6 Members should exchange both historic data archives and current observations of the ECVs listed in 5.8.5 with a tentative maximum delay of one year.

Notes:

1. These are the remaining ECVs that do not have additional requirements listed in this Manual and are not generally observed by NMHSs.
2. More detailed requirements can be found in The 2022 GCOS Implementation Plan (GCOS-244), The 2022 GCOS ECVs Requirements (GCOS-245) and in the RRR process for the application areas which relate to climate monitoring in each of the Earth System Application Categories.

ATTACHMENT 5.1. METEOROLOGICAL VARIABLES TO BE OBSERVED

No.	Variables	Surface synoptic/basic observations on land	Surface marine meteorological observations	Surface observations for climate applications	Surface observations for aeronautical meteorology	Surface observations for agricultural meteorology	Upper-air observations
	[g]	[a]	[b] [f] [i]	[c]	[d]	[e]	[h]
1	Atmospheric pressure	X	X	X	X [8]	X	[X] [9]
2	Pressure tendency and characteristics	[X]	X	X			
3	Air temperature	X	X	X	X	X	[X]
4	Extreme temperatures	[X]	X	X			
5	Humidity	X	X	X	X	X [12]	[X]
6	Surface wind/Horizontal wind	X	X	X	X	X	[X]
7	Wind gust speed	[X]	[X]	[X]	X	[X]	
8	Wind turbulence type and intensity						[X]
9	Present and past weather	{X}	{X}	{X}	{X}	{X}	
10	Special phenomena	[{X}]	[{X}]	[{X}]			
11	Lightning (*)	[X]	[X]	X	[X]		[X]
12	Cloud amount and type (*)	{X}	{X}	{X}	{X} [2]	X [10]	[X]
13	Extinction profile/cloud base (*)	{X}	{X}	X	X [5]		[X]
14	Visibility	{X}	X	X	X [3]	X	
15	Precipitation, amount	[X]	X	X		X	
16	Precipitation, yes/no	{X}	X				
17	Intensity of precipitation	[X]			[X] [4]		
18	Evaporation and transpiration					X	
19	State of the ground	[X]		X	~~X [13]~~		
20	Snow depth	[X]	[X] [1]	X			
21	Soil temperature	[X]	N/A	X		X	
22	Soil moisture			X		X	
23	Sunshine duration and/or solar radiation	[X]	[X]	X		X [11]	
24	Net solar radiation		[X]	X			
25	Radiation (various components)			X			
26	Sea-surface temperature		X	X	X [14]		
27	Wave period		X				
28	Wave height		X	X	X [14]		
29	Wave movement direction		X		X [14]		
30	Sea ice and/or icing of ship superstructure		[X]	X			

31	Course and speed of a mobile sea station/platform		X		X		
32	Sea level		[X]	X			
33	Height of inversion layer/height of mixing layer (*)						[X]
34	Rate of ice accretion						[X]
35	Additional variables for agriculture - see the list below					[X]	
36	Ocean surface heat flux		[X]	X			

Notes:

X This symbol indicates that observation of the variable is mandatory;

{X} This symbol indicates that a variable observed at a manual station may not be feasibly observed at an automatic station;

[X] This symbol indicates that the variable is to be observed, if possible, or if specified by resolutions of the regional association;

[a] WMO global requirements for weather and climate applications associated with the World Weather Watch;

[b] WMO global requirements for weather, climate and ocean applications. All variables measured in the atmosphere or sea surface are meteorological observations required for operational purposes;

[c] Requirements of the Commission for Climatology, supported by GCOS (see Guide to Climatological Practices (WMO No. 100) and The 2022 GCOS ECVs Requirements (GCOS-245));

[d] Requirements of the Commission for Aeronautical Meteorology, supported by ICAO;

[e] Requirements of the Commission for Agricultural Meteorology (see Guide to Agricultural Meteorological Practices (WMO No. 134));

[f] Such an observation may be made from coastal stations on land and surface marine stations;

[g] If the technology is available (manned and automatic);

[h] WMO global requirements for weather and climate applications associated with the World Weather Watch. In most cases, entries in this column indicate vertical profile observations of the relevant variables;

[i] Certain stations/platforms may not have the capability to measure all mandatory elements due to technical constraints;

[1] Snow coverage of sea ice;

[2] Not all cloud types, only those related to turbulence (Cumulonimbus and Towering Cumulus);

[3] Visibility for aeronautical purposes (differs from the Meteorological Optical Range (MOR));

[4] Included as a component of present weather in subjective terms;

[5] Cloud base only;

[6] For helidecks on ships;

[7] Surface radiation budget;

[8] QNH and/or QFE;

[9] To determine altitude;

[10] Cloudiness only;

[11] For agricultural meteorology, also "photoperiod";

[12] Including leaf wetness and dew;

~~[13] The state of the runway is a different variable from the state of the ground, which is reported in METAR/SPECIs;~~

[14] Seasurface temperature and state of the sea or significant wave height are reported as supplementary information (inclusion is conditional, depending on meteorological conditions or method of observation; see: Technical Regulations (WMO No. 49), Volume II, with explanations in ICAO Doc 8896);

(*) in fact: upperair observations.

Additional variables for agriculture:

1. At stations supporting agricultural meteorology, Members are to conduct an observing programme that, in addition to the other meteorological observations being made, includes some or all of the following:
 - (a) Observations of the physical environment:
 - (i) Temperature and humidity of the air at different levels in the layer adjacent to the ground (from ground level up to about 10 m above the upper limit of prevailing vegetation), including extreme values of these meteorological elements;
 - (ii) Soil temperature at depths of 5, 10, 20, 50 and 100 cm and at additional depths for special purposes and in forest areas;
 - (iii) Soil water (volumetric content) at 5, 10, 20, 50 and 100 cm and at additional depths for special purposes and deep soils, with at least three replications when the gravimetric method is used;
 - (iv) Turbulence and mixing of air in the lower layer (including wind measurements at different levels);
 - (v) Hydrometeors and water-balance components (including hail, dew, fog, evaporation from soil and from open water, transpiration from crops or plants, rainfall interception, runoff and water table);

- (vi) Sunshine duration, global and net radiation as well as the radiation balance over natural vegetation, and crops and soils (over 24 hours);
 - (vii) Observations of weather conditions causing direct damage to crops, such as frost, hail, drought, floods, gales and extremely hot, dry winds;
 - (viii) Observations of damage caused by sandstorms and dust storms, rainfall erosivity, atmospheric pollution and acid deposition as well as forest, bush and grassland fires;
 - (ix) Observations of greenhouse gas concentrations and fluxes in the context of climate change processes.
- (b) Observations of a biological nature:
- (i) Phenological observations;
 - (ii) Observations on growth (as required for the establishment of bioclimatic relationships);
 - (iii) Observations on qualitative and quantitative yield of plant and animal products;
 - (iv) Observations of direct weather damage to crops and animals (adverse effects of frost, hail, drought, floods and gales);
 - (v) Observations of damage caused by disease and pests;
 - (vi) Observations of damage caused by sandstorms, dust storms and atmospheric pollution, as well as forest, bush and grassland fires.
2. Members are to make agricultural meteorological observations of the physical environment at the main standard times.
3. Members are to make agricultural meteorological observations of a biological nature regularly, at least every two or three days, or as frequently as significant changes occur.

No.	Variables	Essential Climate Variable (ECV) [a] [d] for GCOS	Remarks
		[a]	[c]
1	Atmospheric pressure	ECV	Pressure at station level and reduced to mean sea level (MSL)
2	Pressure tendency and characteristics		Derived from continuous measurement of atmospheric pressure at station level
3	Air temperature	ECV	At different heights, including grass minimum temperature
4	Extreme temperatures		Minimum and maximum air temperature
5	Humidity	ECV	Dew- or ice-point temperature, mass mixing ratio, liquid water content, relative humidity directly measured or derived from dew-point temperature and air temperature, water vapour pressure.
6	Surface wind/Horizontal wind	ECV	Horizontal component of 3D wind vector at 10 m above surface, expressed in polar (speed and direction) or Cartesian coordinates (North-South and East-West). Averaged over 10 minutes
7	Wind gust speed		From the continuous measurement of surface wind

No.	Variables	Essential Climate Variable (ECV) ² [d] for GCOS	Remarks
8	Wind turbulence type and intensity		
9	Present and past weather		Qualitative description of observable phenomena in the atmosphere including precipitation, suspended or blowing particles, and other designated optical phenomena or electrical manifestations, as described in the International Cloud Atlas: Manual on the Observation of Clouds and Other Meteors (WMO-No. 407), the Guide to Instruments and Methods of Observation (WMO-No. 8) and, for aeronautical applications, in the Technical Regulations (WMO-No. 49), Volume II.
10	Special phenomena		Further guidance for observation of special phenomena is provided in the Guide to the Global Observing System (WMO-No. 488), Part III, 3.2.2.2.11.
11	Lightning (*)	ECV	
12	Cloud amount and type (*)	ECV	Cloud coverage and type as defined in the International Cloud Atlas: Manual on the Observation of Clouds and Other Meteors (WMO-No. 407)
13	Extinction profile/cloud base (*)	ECV	Cloud bases, derived from extinction profile
14	Visibility		Equal to MOR, defined as $3/\sigma$
15	Precipitation, amount	ECV	Expressed in the liquid equivalent {Mass/area} or {Volume/area}. May be derived from continuous measurement of intensity of precipitation; if less than 0.01 mm, it should be indicated as "trace"
16	Precipitation, yes/no	ECV	If intensity of precipitation exceeds 0.001 mm/h
17	Intensity of precipitation		Expressed in the liquid equivalent {Mass/area/period} or {Volume/area/period}. If less than 0.01 mm/h, it should be indicated as "trace"
18	Evaporation and transpiration	ECV	
19	State of the ground		Snow coverage
20	Snow depth	ECV	~~Also water equivalent of snow~~ Also referred as snow height, measured as the vertical distance/height between the reference/ground surface and the top of the snowpack. ; Snow depth is one of the observed variables under the Snow ECV.
21	Soil temperature		At different depths
22	Soil moisture	ECV	At different depths
23	Sunshine duration and/or solar radiation		Duration based on the period sunshine is detected with incoming direct radiation of 120 W/m ²
24	Net solar radiation	ECV (S, U) [1]	Expressed in {Power/area}
25	Radiation (various components)	ECV	Defined by the Baseline Surface Radiation Network (BSRN) programme
26	Sea-surface temperature	ECV (S) [b]	Metadata is important for this variable because there are various methods of observation which produce different results, for example, skin temperature or bulk temperature over 2 m
27	Wave period	ECV (S) [b][2]	
28	Wave height	ECV (S) [b][2]	
29	Wave movement direction	ECV (S) [b][2]	In polar coordinates with reference to True North

No.	Variables	Essential Climate Variable (ECV) ^[d] for GCOS	Remarks
30	Sea ice ~~and/or icing of ship superstructure~~	ECV (S) [b]	<u>Sea Ice ECV includes products (observed variables) Sea Ice Concentration; Sea Ice Thickness; Sea Ice Drift; Sea Ice Age; Sea Ice Temperature; Sea Ice Surface Albedo; Snow Depth on Sea Ice</u>
31	Course and speed of a mobile sea station/platform		In polar coordinates with reference to True North
32	Sea level	ECV (S) [b]	With reference to MSL, also for coastal observations
33	Height of inversion layer/ height of mixing layer (*)		
34	Rate of ice accretion		<u>It covers ice accretion on ship superstructures</u>
35	Additional variables for agriculture, see list above		
36	Ocean surface heat flux	ECV	

Notes:

[a] GCOS requirements: S = surface, U = upperair; see The GCOS Implementation Plan (GCOS-244), and The 2022 GCOS ECVs Requirements (GCOS-245);

[b] This variable is also an Essential Ocean Variable (EOV) as specified by the Global Ocean Observing System (GOOS); see <http://www.goosocean.org/>;

[c] If the technology is available (manned and automatic);

[d] An ECV is a physical, chemical or biological variable (or group of linked variables) that critically contributes to the characterization of Earth's climate. The ECVs must not be understood as a select group of stand-alone variables; they are part of a wider concept (see The GCOS Implementaiton Plan (GCOS-244)).

[1] For surface: Surface Radiation Budget; for upperair: Earth Radiation Budget;

[2] This variable is part of ECV and EOv, described as "Sea state";

(*) in fact: upperair observations.

6. ATTRIBUTES SPECIFIC TO THE OBSERVING COMPONENT OF THE GLOBAL ATMOSPHERE WATCH

Note:

1) The provisions of sections 1, 2, 3 and 4 are common to all WIGOS component observing systems, including GAW. The provisions in this section are specific to GAW.

2) Emerging operational systems for atmospheric composition may have different requirements from those formulated under this chapter.

6.1 REQUIREMENTS

6.1.1 Members should perform the observations of atmospheric composition and related physical parameters using a combination of surface-based stations and platforms (fixed stations, mobile platforms and remote sensing) and space-based platforms.

6.1.2 When developing their GAW stations, Members should use the requirements from the RRR process, ~~particularly in the areas of forecasting of atmospheric composition, and monitoring of atmospheric composition and atmospheric composition for urban applications.~~

Notes:

1. The user requirements are reviewed on a regular basis through the RRR process by the Scientific Advisory Groups (SAGs) for each variable, in consultation with the user community and with input from Members. The RRR process is described in section 2.2.4 and Appendix 2.1.
2. Scientific Advisory Groups exist for the six GAW focal areas and their terms of reference are defined by the Research Board.

6.1.3 Members should follow the data quality objectives specified by the GAW Programme for the individual variables observed.

6.1.4 Members should establish and operate their GAW stations in accordance with the specifications provided in the *WMO Global Atmosphere Watch (GAW) Implementation Plan: 2016–2023* (GAW Report No. 228), Annex B: Station and network definitions and operations.

Note: The specifications provided in the referenced GAW implementation plan remain valid beyond the specified period of the plan.

6.1.5 Members operating GAW stations shall undertake long-term and uninterrupted operation with the stability and continuity of data collection required for the purposes outlined in 6.2.1.

6.2 DESIGN, PLANNING AND EVOLUTION

6.2.1 Members should design, plan and further develop their GAW observing network and stations to address user requirements, in particular those that concern key environmental issues and application areas, including but not limited to changes in the weather and climate related to human influence on atmospheric composition, particularly on greenhouse gases, ozone and aerosols; impacts of air pollution on human and ecosystem health and issues involving long-range transport and the deposition of air pollution; and changes in UV radiation as a consequence of changes in atmospheric ozone amounts and climate.

6.2.2 Members should contribute observations through operating or supporting suitable platforms at GAW stations and/or through contributing networks.

6.2.3 When doing so, Members shall register their contribution in GAW SIS and submit their observations to the relevant world data centre.

Note: The GAW Station Information System is the official catalogue for monitoring sites, platforms or stations operating within GAW and related programmes, providing station metadata and serving as the clearing house for unique station identifiers. The GAW Station Information System represents the metadata source for OSCAR for GAW observations.

6.2.4 **Members and other entities operating a contributing network shall provide a description of the network, register the stations in GAW SIS and provide corresponding metadata.**

6.2.5 Members should ensure that the frequency and spacing of the various observations is suited to the temporal and spatial requirements of the specific issues addressed in section 6.2.1.

6.3 INSTRUMENTATION AND METHODS OF OBSERVATION

6.3.1 General requirements of instruments

Members should use recommended types of instrument and method of observation for variables observed at their stations, and should follow further available guidance.

Notes:

1. Guidance is provided in the Standard Operating Procedures (SOPs) and measurement guidelines.
2. Instruments suitable for use at GAW sites are defined by the SAGs for each parameter, in terms of stability, precision and accuracy.
3. Standard operating procedures describe the standard approach to operating such instruments.
4. The measurement guidelines describe the standard approach for this kind of measurement regardless of the instrument.

6.3.2 Calibration and traceability

6.3.2.1 **Members shall perform calibrations and maintain traceability to the GAW WMO primary standards, where available.**

Notes:

1. The GAW primary standard is a single network standard, assigned by WMO for each individual variable. In the case of contributing networks, network observations are traceable to the network standard, which in turn is traceable to the GAW primary standard.
2. Details of calibrations are specified by the SOPs and measurement guidelines.

6.3.2.2 Members should utilize GAW central facilities to ~~sustain~~ensure the global compatibility of observations.

Note: The GAW central facilities include: central calibration laboratories, world calibration centres, regional calibration centres and quality assurance/science activity centres.

6.4 OPERATIONS

6.4.1 Monitoring observing system implementation

6.4.1.1 **Members shall monitor the operation of GAW stations for which they are responsible and shall ensure that they follow the relevant procedures for quality assurance and data submission. Members shall seek assistance from central facilities, SAGs and expert teams if operational problems cannot be solved locally.**

Note: The procedures to be used in monitoring the operation of GAW are determined by the Research Board in consultation with the participating Members.

6.4.1.2 Members should systematically monitor compliance with GAW regulations, in collaboration with relevant constituent bodies and the WMO Secretariat, in order to identify critical cases of non-compliance (deficiencies) and undertake measures for their timely resolution.

6.4.2 Quality assurance

6.4.2.1 Members should follow specified quality assurance practices and procedures.

Note: Details are given in the GAW SOPs and measurement guidelines and in further documents provided by the SAGs, expert teams and central facilities.

6.4.2.2 Members shall maintain detailed metadata records in accordance with procedures and practices specified in this Manual.

6.4.2.3 Members should participate in independent evaluations of quality of observations, including intercomparisons and system audits, as appropriate for the observed variables.

6.4.2.4 Members shall allow world data centres to perform an independent evaluation of the data quality of their observations.

6.4.3 Data and metadata representation and format

6.4.3.1 Members shall submit their observational data and associated metadata to the relevant world data centres for the variables observed at the station within agreed time limits.

6.4.3.2 Members shall use the formats specified by the relevant world data centre when submitting their observational data and metadata.

6.5 OBSERVATIONAL METADATA

Note: The general provisions on observational metadata are specified in section 2.5.

6.5.1 Members shall provide metadata associated with the instrumentation, site or platform, and calibration history as requested by the world data centre for each parameter and by GAWSIS.

6.5.2 Members shall provide additional metadata required by GAWSIS and by any world data centre to which they contribute to enable the understanding of their observations.

6.6 QUALITY MANAGEMENT

Note: The general regulations on quality management are specified in section 2.6.

6.7 CAPACITY DEVELOPMENT

Note: General provisions for capacity development are provided in sections 2.7 and 4.8.

6.7.1 Members unable to implement required standards should establish agreements with appropriate central facilities or establish partnerships with more experienced stations in the form of station twinning.

Note: In some regions of the world, and for some GAW variables, where there is a clear lack of capacity, Members may be requested to support a station, or existing stations may be approached to become part of GAW. Such requests and invitations come after approval by the appropriate SAG(s).

6.7.2 Members should use the GAW Training and Education Centre (GAWTEC) programme, as available, for capacity-building and staff training in measurement of the specific GAW variables.

7. ATTRIBUTES SPECIFIC TO THE WMO HYDROLOGICAL OBSERVING SYSTEM

Note: The provisions of sections 1, 2, 3 and 4 are common to all WIGOS component observing systems, including WHOS. The provisions of this section are specific to WHOS.

7.1 REQUIREMENTS

7.1.1 Members shall establish and operate a hydrological observing system according to their national requirements.

7.1.2 Members should also operate their hydrological observing systems to address the requirements of the RRR process, in particular for the hydrology application area.

Notes:

1. A hydrological observing system includes networks of hydrological observing stations, as defined in the Technical Regulations (WMONo. 49), Volume III, Chapter 2. Such observing stations should make observations of the elements described in 2.9.
2. Information on hydrological data transmission can be found in the Technical Regulations (WMONo. 49), Volume III, Chapter 2. Further provisions for data transmission and international exchange through the WIS are laid out in the Technical Regulations (WMONo. 49), Volume I, Part II, the Manual on the WMO Information System (WMONo. 1060) and the Manual on the Global Telecommunication System (WMONo. 386).

7.1.3 Members shall provide on a free and unrestricted basis those hydrological data and products that are necessary for the provision of services for the protection of life and property, and the well-being of all peoples.

7.1.4 Members should also provide, where available, additional hydrological data and products that are required by WMO Programmes and by Members as specified in paragraph 7.1.2.

7.1.5 At the global level, WHOS shall give Members access to near-real-time hydrological observations from all Members.

Note: Currently, many Members are making such observations publicly available on the Internet.

7.1.6 Members who make near-real-time hydrological observations publicly available on the Internet should provide these observations to WHOS.

7.2 DESIGN, PLANNING AND EVOLUTION

Note: Design, planning and evolution is common to all WIGOS component observing systems.

Members should design and plan their observing network bearing in mind the review of the current and planned WHOS capabilities, undertaken as outlined in the RRR described in section 2.2.4.

7.3 INSTRUMENTATION AND METHODS OF OBSERVATION

7.3.1 General requirements of instruments

7.3.1.1 Members should equip their stations with properly calibrated instruments and should arrange for these stations to follow adequate observational and measuring techniques to ensure that the measurements and observations of the various hydrological elements are accurate enough to address the needs of hydrology and other application areas.

Note: Technical Regulations (WMONo. 49), Volume III, provides that Members should use instruments for measurement of stage (water level) in conformity with the specifications of its annex, section II: Waterlevel measuring devices.

7.3.1.2 Members should ensure that the uncertainty in the observation of the stage (water level) of rivers, estuaries, lakes and reservoirs does not exceed:

- (a) In general, 10 mm at the 95% confidence level;
- (b) Under difficult conditions, 20 mm at the 95% confidence level.

Note: Stage (water level) observations are used primarily as an index for computing streamflow discharge when a unique relation exists between stage (water level) and discharge.

7.3.2 Stage and discharge observations from hydrometric stations

Note: Technical Regulations (WMONo. 49), Volume III, provides that Members should establish and operate hydrometric stations for measuring stage (water level), velocity and discharge in conformity with the specifications of its annex, section VI: Establishment and operation of a hydrometric station.

7.3.2.1 Members should ensure that the number of discharge measurements at a stream gauging station allows the rating curve for the station to be defined at all times.

Notes:

1. Technical Regulations (WMONo. 49), Volume III, provides that Members should use the methods for determining the stagedischarge relation (rating curve) of a station as specified in its annex, section VII: Determination of the stagedischarge relation.
2. Technical Regulations (WMONo. 49), Volume III, provides that Members should ensure, when undertaking movingboat discharge measurements, that equipment and operational procedures are as specified in its annex, section XII: Discharge measurements by the movingboat method.

7.3.2.2 Members should measure river discharge to an accuracy commensurate with flow and local conditions. Percentage uncertainty of the discharge measurement should not exceed:

- (a) In general, 5% at the 95% confidence level;
- (b) Under difficult conditions, 10% at the 95% confidence level.

Notes:

1. Technical Regulations (WMONo. 49), Volume III, provides that Members should evaluate the uncertainty in discharge measurements in conformity with the specifications in its annex, section VIII: Estimation of uncertainty of discharge measurements.
2. Discharge measurements are taken to establish and verify the stability of a rating curve. Stage (water level) observations are converted to estimates of discharge using the rating curve on an ongoing basis.

7.3.3 Calibration procedures

Notes:

1. Technical Regulations (WMONo. 49), Volume III, provides that Members should adhere to the specifications of facilities, equipment and procedure for the calibration of current meters as specified in its annex, section I: Calibration of current meters in straight open tanks.

2. Technical Regulations (WMO No. 49), Volume III, provides that Members should ensure that operational requirements, construction, calibration and maintenance of rotating element current meters are as specified in its annex, section IV: Rotating element type current meters.

Members should recalibrate acoustic velocity meters on a routine basis to ensure stability of the calibration, using measurement standards traceable to international or national standards. Where no such standards exist, Members should record the basis used for calibration or verification.

Note: Additional information pertaining to the calibration of instruments can be found in the Guide to Hydrological Practices (WMO No. 168), Volume I, 2.3.4, and in the Manual on Stream Gauging (WMO No. 1044), Volume I, 5.3, 6.4 and 6.5.

7.4 OPERATIONS

7.4.1 Observing practices

7.4.1.1 Members should collect and preserve their hydrological records.

7.4.1.2 Members should make the necessary arrangements to facilitate the retrieval and analysis of their hydrological observations by means of automatic data-processing equipment.

7.4.1.3 Where automatic registration is not available, Members should ensure that the observations of elements for hydrological purposes are made at regular intervals appropriate for the elements and their intended purposes.

7.4.1.4 Members should maintain in their archives an up-to-date inventory of their hydrological observations.

7.4.1.5 Members should generally ensure uniformity in observation times within a catchment area.

7.4.1.6 Members should select the time units used in processing hydrological data for international exchange from the following:

- (a) The Gregorian calendar year;
- (b) The months of this calendar;
- (c) The mean solar day, from midnight to midnight, according to the zonal time, when the data permit;
- (d) Other periods by mutual agreement in the case of international drainage basins or drainage basins in the same type of region.

7.4.1.7 For hydrometric stations where data are internationally exchanged, Members should process the following characteristics for each year:

- (a) Maximum instantaneous and minimum daily mean values of stages (water levels) and discharge;
- (b) Mean daily stages (water levels) and/or mean daily discharges.

7.4.1.8 For rivers under flood conditions or where there are variable controls, Members should make special measurements at intervals frequent enough to define the hydrograph.

7.4.1.9 When sudden and dangerous increases in river levels occur, Members should make and report observations as soon as possible regardless of the usual time of observation, to meet the intended operational use.

7.4.1.10 Members should measure and store stage (water level) observations as instantaneous values rather than averaged values.

7.4.2 Quality control

7.4.2.1 Members should maintain detailed records for each station and for each parameter containing metadata related to the measurements, maintenance and calibration of equipment.

7.4.2.2 Members should perform periodic audits of their stations and collected data.

7.4.2.3 Members should ensure that recorded hydrological observations are converted to a form suitable for archiving and retrieval.

Note: Observations may initially be recorded using various media from paper to electronic form. As computer archiving has become a standard practice for most Members, it is advantageous to convert data to the required format early in the process.

7.4.2.4 Members should ensure that their data undergo, at various stages, a range of checks to determine their uncertainty and correctness.

7.4.2.5 With accelerating developments in technology, Members should ensure that data-processing and quality control systems are well-organized and that the relevant staff are trained to understand and use them.

Note: Data are collected and recorded in many ways, ranging from the manual reading of simple gauges to a variety of automated datacollection, transmission and filing systems.

7.4.2.6 Members should consider the adoption of a quality management system, as described in section 2.6.

Note: Organizations usually employ an accredited certification agency to provide independent verification.

7.4.2.7 Members should undertake data processing and quality control as described in relevant publications.

Note: Such publications include the Guide to Hydrological Practices (WMONo. 168), Volume I, Chapter 9, the Manual on Flood Forecasting and Warning (WMONo. 1072), Chapter 6, and the Manual on Stream Gauging (WMONo. 1044), Volume II, Chapter 6.

7.4.3 Observations and observational metadata reporting

7.4.3.1 Members should ensure, when providing hydrological information for international purposes, that open text or appropriate code forms are used as specified in bilateral or multilateral agreements.

7.4.3.2 Members should ensure that transmission facilities are organized for the international exchange of hydrological observations on the basis of bilateral or multilateral agreements.

7.4.3.3 In order to make data globally available for real-time exchange and discovery, access and retrieval, Members should report stage and discharge observations in compliance with WIS metadata standards.

Notes:

1. The WMO Information System may also be used for access to hydrological observations not required in real time.
2. The regulations governing exchanges in international code forms are specified in the *Manual on Codes* (WMONo. 306), Volumes ~~I.1~~ I.2 and I.3.
3. Coded information exclusively for bilateral or multilateral exchange amongst Members may be in other forms by mutual agreement.

7.4.4 Incident management

Note: General provisions for incident management are provided in section 2.4.5.

7.4.5 Change management

Note: General provisions for change management are provided in section 2.4.6.

7.4.6 Maintenance

7.4.6.1 Members should determine the frequency and timing of visits to recording stations on the basis of the length of time that the station can be expected to function without maintenance and the uncertainty requirements of the data.

Notes:

1. There is a relation between the frequency of the visits and the resultant quality of the data collected. Too long a time between visits may result in frequent recorder malfunction and thus in loss of data, while frequent visits are both timeconsuming and costly.
2. Some data collection devices may suffer a drift in the relationship between the variable recorded and that represented by the recorded value. An example of this is a nonstable stagedischarge relationship.
3. Two visits per year are considered an absolute minimum. More frequent visits are recommended to decrease the potential loss of data and to avoid data being severely affected by problems such as silting, vandalism or seasonal vegetative growth.

7.4.6.2 Members should schedule periodic visits to the station to recalibrate the equipment or the measurement equations.

7.4.6.3 Members should periodically inspect stations using trained personnel to ensure the correct functioning of instruments.

7.4.6.4 Members should ensure that a formal written inspection is done routinely, preferably each year, to check overall performance of instruments and local observer, if applicable.

7.4.6.5 Members, when routinely inspecting sites, should:

- (a) Measure gauge datum to check for and record any changes in levels;
- (b) Check the stability of the rating curve and review the relationships between the gauges and permanent level reference points to verify that no movement of the gauges has taken place;
- (c) Review the gauging frequency achieved and the rating changes identified;
- (d) Undertake a number of maintenance activities as described in sections 7.4.6.8 and 7.4.6.9.

Note: It is vital, for the quality of data, that resources for gauging be allocated and prioritized using rigorous and timely analysis of the probability and frequency of rating changes.

7.4.6.6 Members should ensure that maintenance activities are conducted at data-collection sites at intervals sufficient to ensure that the quality of the data being recorded is adequate.

7.4.6.7 Members should ensure that such activities are conducted by the observer responsible for the sites, if there is one. Members should also ensure that maintenance activities are occasionally performed by an inspector.

7.4.6.8 Members should undertake the following maintenance activities at all collection sites:

- (a) Service the instruments;
- (b) Replace or upgrade instruments, as required;
- (c) Retrieve or record observations;
- (d) Perform the recommended checks on retrieved records;
- (e) Carry out general checks of all equipment, for example, transmission lines;
- (f) Check and maintain the site in accordance with the recommended specifications;
- (g) Check and maintain access to the station;
- (h) Record, in note form, all of the above activities;
- (i) Comment on changes in land use or vegetation;
- (j) Clear debris and overgrowth from all parts of the installation.

7.4.6.9 Members should undertake the following maintenance activities at discharge collection sites:

- (a) Check the bank stability, as necessary;
- (b) Check the level and condition of gauge boards, as necessary;
- (c) Check and service the flowmeasuring devices such as cableways, as necessary;
- (d) Check and repair control structures, as necessary;
- (e) Regularly survey crosssections and take photographs of major station changes after events or changes in vegetation or landuse;
- (f) Record, in note form, all of the above activities and their results;
- (g) Inspect the area around or upstream from the site, and record any significant landuse or other changes in related hydrological characteristics, such as ice.

Note: Further details are found in the Manual on Stream Gauging (WMONo. 1044), Volume I, 4.8.8.

7.4.6.10 Members should have a well-trained technician or inspector visit stations immediately after every severe flood in order to check the stability of the river section and the gauges. Members should train a local observer, if there is one, to check for these problems and communicate them to the regional or local office.

7.4.6.11 Members should not programme flood gaugings as part of a routine inspection trip because of the unpredictable nature of floods.

7.4.6.12 Members should establish a flood action plan prior to the beginning of the storm or flood season and should specify priority sites and types of data required.

Note: If flood gaugings are required at a site, the preparations would ideally be made during the preceding dry or nonflood season so that all is ready for the annual flood season.

7.4.6.13 Members should consider undertaking the following additional measures if severe flooding is likely:

- (a) Upgrade site access (helipad, if necessary);

- (b) Equip a temporary campsite with provisions;
- (c) Store and check gauging equipment;
- (d) Protect instrumentation, such as stage recorders, by taking floodproofing measures.

7.4.6.14 Following the recession of floodwaters, Members should pay particular attention to ensuring the safety and security of the data-collection site and to restoring the normal operation of on-site instrumentation.

Note: In some cases, redesign and reconstruction of the site may be required. Such work would ideally take into account information obtained as a result of the flood.

7.4.7 Calibration procedures

Note: Determination of a rating curve is described in section 7.3.2. Calibration procedures for current meters are described in section 7.3.3.

7.5 OBSERVATIONAL METADATA

Notes:

1. Provisions for describing, recording and retaining, and for exchanging and archiving observational metadata are provided in section 2.5. These apply to all WIGOS component observing systems including WHOS. Further provisions specific to WHOS are stated here.
2. The observational metadata are detailed in Appendix 2.4 and in the [WIGOS Metadata Standard](#) (WMONo. 1192).
3. Within an organization or country, a hydrological information system, a station registration file and a historical operation file (as indicated in the Guide to Hydrological Practices (WMO-No. 168), Volume I, Chapter 2, 2.5.2.2, and Chapter 10, 10.2) or similar repositories may be used as a convenient means to compile a set of metadata about a hydrological station and its observations.

7.5.1 Members who use their own station identifiers for hydrological stations should maintain the means to match these with the WIGOS station identifiers, as specified in section 2.4 and Attachment 2.1.

7.5.2 Members should collect and record additional observational metadata identifying the purpose of the station in accordance with the provisions in section 2.5.

Note: Further details are found in the Guide to Hydrological Practices (WMONo. 168), Volume I, Chapter 10.

7.6 QUALITY MANAGEMENT

Notes:

1. Provisions for the implementation of quality management in WIGOS are provided in section 2.6. These apply to all WIGOS component observing systems including WHOS.
2. The WMO Hydrology and Water Resources Programme has developed material on the implementation of the WMO Quality Management Framework in Hydrology and its adoption in national operations. Some Members have achieved compliance with the ISO 9001:2015 standard (*ISO 9001:2015 Quality management systems — Requirements*) and examples have been documented to assist other Members.

7.7 CAPACITY DEVELOPMENT

Notes:

1. Provisions for the implementation of capacity development in WIGOS are provided in section 2.7.
2. Whatever the level of technical sophistication of a datacollection authority, the quality of its staff remains its most valuable resource.

7.7.1 Members should undertake careful recruitment, training and management to attain and maintain suitable personnel with the most appropriate skill sets.

7.7.2 Members should pursue a carefully structured training programme for all personnel engaged in field and office practices pertaining to data collection because they are in a strong position to influence the quality of the final data.

Note: Formal training ideally will aim at providing both a general course in basic principles and training modules to teach inhouse field and office procedures. All material has to be relevant and current.

7.7.3 Members should provide training classes, follow-up exercises and on-the-job training to field personnel, before they make streamflow and topographic measurements using various technologies such as Acoustic Doppler Current Profiler (ADCP) and mechanical current meters.

7.7.4 Members should provide training classes, follow-up exercises and on-the-job training on data-collection practices and processing of data to increase employee productivity and programme effectiveness.

7.7.5 Members should have appropriate technologies in place, such as hydrological information systems, to allow for streamflow data processing and to facilitate the effective and efficient delivery of metadata, data and data products to users.

7.7.6 Members should have an adequate number of stations to meet priority needs and should ensure sufficient resources to maintain and operate sites to attain required accuracies and reliability of data for their intended use.

8. ATTRIBUTES SPECIFIC TO THE OBSERVING COMPONENT OF THE GLOBAL CRYOSPHERE WATCH

Note: The provisions of sections 1, 2, 3 and 4 are common to all WIGOS component observing systems, including GCW. The provisions in this section are specific to GCW.

8.1 Cryosphere components shall be: solid precipitation, snow, glaciers and ice caps, ice sheets, ice shelves, icebergs, sea ice, lake ice, river ice, permafrost and seasonally frozen ground.

Notes:

1. Members may perform observations of any variables of any of these components.
2. Members may use different platforms (fixed stations, mobile platforms, virtual sites and remote sensing) to perform cryospheric observations.

8.2 Members should collaborate actively in, and give all possible support to, the development and implementation of the observing component of GCW.

Notes:

1. The scope of GCW encompasses surface and spacebased observations, the application of observing standard and recommended practices and procedures for the measurement of cryospheric variables, and full assessment of in situ and satellite products.
2. The initial focus of the observing component of GCW is to promote cryospheric observations at existing stations, rather than installing new ones.

8.3 Members should encourage partnerships between organizations to coordinate observing, capacity-building and training activities relevant to cryospheric observations, and to assist with the compilation and development of standard and recommended practices and procedures for cryospheric observations.

8.4 Members concerned shall ensure that their observations from GCW stations are accessible through the GCW data portal.

Notes:

1. This is the specific means for GCW stations to comply with provision 2.4.4.1.
2. By ensuring their GCW station observations are made available, Members are helping to promote the incorporation of cryospheric observations into GCW data products and services.

8.5 Members concerned shall clearly identify in OSCAR/Surface which stations belong to the GCW surface observing network and which belong to CryoNet.

8.6 Members operating stations of the GCW surface observing network shall apply GCW best practices and procedures.

Note: Global Cryosphere Watch best practices and procedures are published in the Guide to Instruments and Methods of Observation (WMONo. 8), Volume II. Such guidance material will help Members to understand and comply with technical regulations.

8.7 The GCW surface observing network shall comprise a core component, called CryoNet, and stations of affiliated networks.

Notes:

1. Members are encouraged to apply GCW recommended best practices at all cryosphereobserving stations in existing programmes and networks, and to apply for the designation of these stations as CryoNet or CryoNet contributing stations. The Global Terrestrial Network for Permafrost (GTNP) is one such network; it is responsible for defining monitoring strategies and establishing data protocol for its network. Stations in the WMO RBON, which measure at least one cryospheric variable, already follow WMO guidelines for observation standards and exchange protocols.
2. Guidance on the process for applying for designation as a GCW station and the criteria for acceptance are available at <https://globalcryospherewatch.org/> and in the Guide to Instruments and Methods of Observation (WMONo. 8), Volume II.
3. Guidance regarding which networks are identified as affiliated networks, and how their nondesignated stations are identified as components of GCW (either as CryoNet or CryoNet contributing stations), is available at <https://globalcryospherewatch.org/> and in the Guide to Instruments and Methods of Observation (WMONo. 8), Volume II.

8.8 The basic constituent part of the GCW surface observing network shall be a GCW station.

Note: A GCW station could be a CryoNet station, a CryoNet contributing station, or a station of an affiliated network.

8.9 CryoNet shall comprise CryoNet stations, CryoNet contributing stations, and CryoNet clusters.

8.10 A CryoNet station shall meet the minimum set of requirements specified in Appendix 8.1, Part I.

8.11 A CryoNet station shall be either a primary or a reference station:

- (a) A primary CryoNet station shall be intended for longterm operations and make at least a fouryear initial commitment;**
- (b) A reference CryoNet station shall have a longterm operational commitment and data records of at least 10 years.**

Note: Any CryoNet station may have one or more additional attributes:

- (a) It can be a calibration/validation station, used for calibration and/or validation of satellite products and/or Earth system models, or it has been used for such purposes in the past and still provides the necessary facilities;
- (b) It can be a research station having a broader research focus related to the cryosphere.

8.12 A CryoNet contributing station shall be a station that provides or provided observations of one or more variables of one or more cryospheric components.

Notes:

1. CryoNet contributing stations that do not satisfy all six requirements listed in Appendix 8.1, Part I, and thus do not meet minimum requirements for a CryoNet station, are nevertheless encouraged to satisfy as many of those requirements as possible.
2. CryoNet contributing stations are not required to provide ancillary meteorological observations. They may be operating in remote, hard-to-access regions, where cryospheric observations are scarce, and they may complement other cryospheric measurement programmes. These stations may have data records that are short or with large gaps.
3. CryoNet contributing stations may have the reference attribute (see 8.11 (b) above).
4. CryoNet contributing stations which have access to meteorological observations from the meteorological station at a representative location, could apply to form together a CryoNet Cluster, in which case the grouping needs to meet the criteria for a CryoNet station.

8.13 A CryoNet cluster shall comprise two or more active stations with coordinated operations or access to data, of which at least one shall be a CryoNet station or a CryoNet contributing station together with a station providing representative meteorological observations, and which together, meet the requirements for a CryoNet station.

8.14 A CryoNet cluster shall meet the requirements specified in Appendix 8.1, Part II.

Note: A CryoNet cluster may cover several microclimatological regions or may extend over larger altitude gradients. Thus, additional ancillary meteorological stations may be part of a CryoNet cluster. Stations in a cluster may be operated by different partners, while their operation is coordinated through one agency or institute.

8.15 A CryoNet cluster shall be basic or integrated:

- (a) **Basic CryoNet clusters shall monitor one component of the cryosphere and shall observe multiple variables of that component;**
- (b) **Integrated CryoNet clusters shall monitor at least two components of the cryosphere or at least one cryosphere component and one other part of the Earth system. Integrated clusters shall promote, through worldwide scientific collaboration, progress in the scientific understanding of the processes that change the cryosphere.**

Note: Typically, integrated clusters have a broader research focus than basic clusters. Whereas basic clusters investigate only the cryosphere, integrated clusters aim to provide a better understanding of the cryosphere and its linkages to other parts of the Earth system, for example, the atmosphere, the hydrosphere, the biosphere, the oceans, soil or vegetation.

APPENDIX 8.1. MINIMUM REQUIREMENTS FOR GLOBAL CRYOSPHERE WATCH CRYONET STATIONS AND CRYONET CLUSTERS

1. MINIMUM REQUIREMENTS FOR A CRYONET STATION

1. Core CryoNet measurement requirements: **The station shall measure at least one variable of one of the cryospheric components. The station location shall be chosen so that cryospheric measurements are representative of the surrounding region, and such representativeness shall be described.**
2. Commitment of operational continuity: **The station shall be active. The responsible agencies shall be committed, to the extent reasonable, to sustaining**

long-term observations of at least one cryospheric component. There shall be a commitment to continuing measurements for at least four years.

3. Up-to-date and available metadata: **The station metadata, including all metadata describing the station characteristics and observing programme, shall be kept up to date and provided to the Global Cryosphere Watch (GCW) portal and to the WIGOS Information Resource (WIR) – [OSCAR/Surface](#).**
4. Compliance with regulatory practices: **The station observational procedures, instruments and methods of observation, quality control practices, and so forth, shall follow GCW-endorsed regulations.**
5. Freely available data and ancillary data: **Data shall be made freely available and, whenever possible, in (near) real time. In situ ancillary meteorological observations, as required by CryoNet practices, shall also be available with documented quality.**
6. Competency of staff: **Personnel shall be trained in the operation and maintenance of the station.**

2. REQUIREMENTS FOR A CRYONET CLUSTER

1. A cluster should encompass observations over an area larger than a conventional observing station;
2. **Integrated clusters shall have technical support staff;**
3. **Integrated clusters shall have training capability;**
4. **There shall be a longterm financial commitment for the comprising stations;**
5. **Data shall be made freely available and, whenever possible, in (near) real time.**
6. **A cluster concept outlining the research approach, data access and use, and relevant engagements shall be provided in support of registration.**

Рекомендация 5 (ИНФОМ-3)

Глобальная опорная сеть наблюдений (ГОСН) и Фонд финансирования систематических наблюдений (ФФСН)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на [резолюцию 2 \(Кг-Внеоч.\(2021\)\)](#) «Поправки к Техническому регламенту, касающиеся создания Глобальной опорной сети наблюдений»,

рассмотрев проект поправок к [Наставлению по Интегрированной глобальной системе наблюдений ВМО](#) (ВМО-№ 1160), представленный в дополнении к проекту резолюции №Nº/1 ИС-78 [рекомендации 4 \(ИНФОМ-3\)](#),

принимая к сведению доклад о деятельности Фонда финансирования систематических наблюдений (ФФСН) в 2023 году,

изучив проект обновлений *Руководства по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1165), представленный в дополнении к *резолюции 4 (ИНФОМ-3)* и касающийся мониторинга соответствия морских станций приземных наблюдений ГОСН в ИЭЗ,

рекомендует Исполнительному совету поощрять соблюдение требований ГОСН, настоятельно призывать Членов оказывать поддержку Многостороннему партнерскому целевому фонду Организации Объединенных Наций ФФСН и продолжать настоятельно призывать к расширению ФФСН, поскольку ресурсы позволяют оказывать поддержку морским станциям приземных наблюдений в ИЭЗ, посредством проекта резолюции, представленного в дополнении к настоящей рекомендации.

Дополнение к рекомендации 5 (ИНФОМ-3)

Проект резолюции №№/1 (ИС-78)

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на *резолюцию 2 (Кг-Внеоч.(2021))* «Поправки к Техническому регламенту, касающиеся создания Глобальной опорной сети наблюдений» и требования ГОСН, перечисленные в *Наставлении по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1160), *раздел 3.2.2*, ГОСН,

отмечая критерии соответствия требованиям ГОСН, изложенные в *Руководстве по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1165),

рассмотрев проект поправок к *Наставлению по Интегрированной глобальной системе наблюдений ВМО* (ВМО-№ 1160), представленный в дополнении к проекту резолюции №№/1 ИС-78 *рекомендации 4 (ИНФОМ-3)*,

принимая к сведению доклад о деятельности ФФСН в 2023 году,

отмечая, что строительство, эксплуатация и обслуживание океанских станций наблюдения намного сложнее, чем строительство, эксплуатация и обслуживание наземных станций,

призывает Членов улучшить соблюдение ими положений, касающихся ГОСН, на уровне станций и Членов;

призывает далее Членов использовать морские станции приземных наблюдений;

настоятельно призывает Членов рассмотреть возможность внесения финансовых взносов в Многосторонний целевой фонд Организации Объединенных Наций Фонда финансирования систематических наблюдений (ФФСН) для устранения критических пробелов в ГОСН;

порукает Генеральному секретарю предложить Руководящему комитету ФФСН рассмотреть вопрос о расширении текущей сферы охвата ФФСН, насколько позволят ресурсы, для включения в нее морских станций/платформ приземных наблюдений ГОСН в ИЭЗ;

порукает далее Генеральному секретарю предложить Руководящему комитету ФФСН сотрудничать с ИНФОМ в разработке соответствующих механизмов для представления отзывов Членов для их совместного рассмотрения.

Более подробную информацию см. в документе INFCOM-3/INF. 8.1(4).

Рекомендация 6 (ИНФОМ-3)

Поправки к Наставлению по Информационной системе ВМО

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 25 \(Кг-19\)](#) «Технический регламент Информационной системы ВМО 2.0»;
- 2) [резолюцию 34 \(ИС-76\)](#) «Обновление Плана осуществления Информационной системы ВМО 2.0»,

подтверждая:

- 1) настоятельную необходимость внедрения ИСВ 2.0 для поддержки Единой политики ВМО в области данных ([резолюция 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля»), Глобальной опорной сети наблюдений ([резолюция 2 \(Кг-Внеоч.\(2021\)\)](#) «Поправки к Техническому регламенту, касающиеся создания Глобальной опорной сети наблюдений») и инициативы «Заблаговременные предупреждения для всех» ([резолюция 4 \(Кг-19\)](#) «Инициатива Организации Объединенных Наций „Заблаговременные предупреждения для всех“»);
- 2) настоятельную потребность в разработке необходимой технической и нормативной основы для обеспечения международного обмена данными по всем дисциплинам и областям в соответствии с требованиями Единой политики ВМО в области данных ([резолюция 1 \(Кг-Внеоч.\(2021\)\)](#)),

признавая необходимость предоставления консолидированного свода технических правил и руководств, чтобы позволить Членам подготовиться к оперативному внедрению ИСВ 2.0 начиная с января 2025 года,

отмечая успешное завершение пилотного этапа ИСВ 2.0 и прогресс на предоперативном этапе, о чем сообщается в документе INFCOM-3/INF. 8.3(2b),

рекомендует Исполнительному совету принять поправки к [Наставлению по Информационной системе ВМО \(ВМО-№ 1060\)](#), том II — Информационная система ВМО 2.0 посредством проекта резолюции, представленного в дополнении к настоящей рекомендации.

Дополнение к рекомендации 6 (ИНФОМ-3)

Проект резолюции ##/1 (ИС-78)

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на:

- 1) [резолюцию 25 \(Кг-19\)](#) «Технический регламент Информационной системы ВМО 2.0»;

- 2) [резолюцию 34 \(ИС-76\)](#) «Обновление Плана осуществления Информационной системы ВМО 2.0»,

признавая необходимость предоставления консолидированного свода технических правил и руководств, чтобы позволить Членам подготовиться к оперативному внедрению ИСВ 2.0 начиная с января 2025 года,

отмечая успешное завершение пилотного этапа ИСВ 2.0 и прогресс на предоперативном этапе, о чем сообщается в документе INFCOM-3/INF. 8.3(2b),

изучив [рекомендацию 6 \(ИНФКОМ-3\)](#),

согласившись с [рекомендацией 6 \(ИНФКОМ-3\)](#),

постановляет принять поправки к [Наставлению по Информационной системе ВМО \(ВМО-№ 1060\)](#), том II — Информационная система ВМО 2.0, приведенные в дополнении к настоящей резолюции;

настоятельно призывает Членов подготовить свою инфраструктуру и оперативные процессы к внедрению ИСВ 2.0, как описано в [Наставлении по Информационной системе ВМО \(ВМО-№ 1060\)](#) и [Руководстве по информационной системе ВМО \(ВМО-№ 1061\)](#);

порукает ИНФКОМ внимательно отслеживать и изучать эффективность ИСВ 2.0 на предоперативных и оперативных этапах, чтобы в дальнейшем уточнить функции и технические спецификации глобальных служб в ответ на расширение объема базовых данных, и доложить об этом ИНФКОМ-4;

порукает Генеральному секретарю опубликовать исправленный вариант [Наставления по Информационной системе ВМО \(ВМО-№ 1060\)](#), который приводится в дополнении к настоящей резолюции.

Дополнение к проекту резолюции ##/1 (ИС-78)

Amendments to the *Manual on the WMO Information System* (WMO-No. 1060)

Volume II – WMO Information System 2.0

The following amendments are proposed:

- (1) Changes to Manual
- (2) Addition of Appendix D: WIS2 Topic Hierarchy
- (3) Addition of Appendix E: WIS2 Notification Message
- (4) Addition of Appendix F: WMO Core Metadata Profile (version 2)

1. [Changes to *Manual on the WMO Information System, Volume II – WMO Information System 2.0* \(WMO-No. 1060\)](#)

PART I. ORGANIZATION AND RESPONSIBILITIES

1.2 Organization of WIS

1.2.4 ~~GISCs~~ WIS centres may operate one or more global services that collectively ensure the discovery of and access to data within all regions.

...

PART II. DESIGNATION PROCEDURES AND WIS CENTRES

2.1 GENERAL

2.1.2 As required by the *Technical Regulations* (WMO-No. 49), Volume I, Part II, 1.2.3, Congress and the Executive Council shall consider the designation of GISCs and DCPCs based on the recommendations of the Commission for Observation, Infrastructure and Information Systems (INFCOM). The development of INFCOM recommendations includes consultation and coordination with the Commission for Weather, Climate, Water and Related Environmental Services and Applications (SERCOM) and ~~relevant technical commissions that are responsible for the WMO and related international programmes concerned, as well as with~~ the regional associations, as appropriate.

...

2.5 PERFORMANCE REVIEW ~~AUDIT~~ OF WIS CENTRES

2.5.1 Background

2.5.1.1 The ongoing performance of WIS relies on the continued compliance of WIS centres with agreed standards and practices. To this end, GISCs, DCPCs and NCs should have a performance review ~~an audit~~ of their compliance with WIS standards and practices.

2.5.2 Responsibility

2.5.2.1 Members are responsible for ensuring that their centres remain compliant with WIS standards and practices. INFCOM will oversee and support the performance review ~~audit~~ process with the aim of confirming a centre's compliance on a regular basis ~~every eight years for NCs and DCPCs and every four years for GISCs~~.

2.5.3 Procedure

~~Note: Further information on the audit of WIS centres is provided in the Guidance on Technical Specifications of WIS 2.0.~~

...

PART III. FUNCTIONS OF WIS

3.5 FUNCTIONAL REQUIREMENTS OF A GISC

~~3.5.4.4 Each GISC shall participate in the work of the Task Team on GISC (TT-GISC) to optimize the global operational performance and sustainability of WIS.~~

...

3.6 FUNCTIONAL REQUIREMENTS OF A WIS NODE

3.6.2 Provide access to data and discovery metadata

Note: More information on the standardized topic structure is provided in Appendix D. the Guidance on Technical Specifications of WIS 2.0.

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3.7 FUNCTIONAL REQUIREMENTS OF GLOBAL SERVICES

3.7.2 Provision of global service components

3.7.2.1 A WIS centre may provide one or more global service components (Global Broker, Global Cache, Global Discovery Catalogue, Global Monitor).

~~Note: The procedure for designating a WIS centre to provide a global service component is described in the Guidance on Technical Specifications of WIS 2.0.~~

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3.7.5 Functional requirements of a Global Cache

3.7.5.6 A Global Cache shall retain a copy of the discovery metadata records and core data it stores for a duration compatible with the real-time or near-real-time schedule of the data and not less than 24 hours.

~~3.7.5.7 A Global Cache shall replace a discovery metadata record if an updated version is available.~~

~~3.7.5.8 A Global Cache shall retain a copy of a discovery metadata record until a notification is received indicating that the record should be removed.~~

3.7.5.79 A Global Cache shall publish notifications via its Message Broker about copies of the discovery metadata records and core data it makes available. A Global Cache shall use a standardized topic structure when publishing notifications.

...

3.7.6 Functional requirements of a Global Discovery Catalogue

3.7.6.8 A Global Discovery Catalogue shall publish an archive resource once per day, containing all discovery metadata records valid at that time.

4.3 WIS-TECHSPEC-2: PUBLISHING DATA AND DISCOVERY METADATA

4.3.5 Notifications indicating the availability and access URL of new or updated data or discovery metadata shall be published to a Message Broker using the format and protocol specified in the Appendix E, Guidance on Technical Specifications of WIS 2.0.

4.3.6 Notifications indicating the removal of a dataset from WIS shall be published to a Message Broker using the format and protocol specified in Appendix E, the Guidance on Technical Specifications of WIS 2.0.

...

4.4 WIS-TECHSPEC-3: OPERATING A GLOBAL BROKER

4.4.2 At least one Global Broker shall subscribe to notifications published from each WIS node and Global Cache according to the standardized topic structure specified in Appendix D. The topic structure and process to allocate WIS nodes and Global Caches to Global Brokers are described in the Guidance on Technical Specifications of WIS 2.0.

...

4.5 WIS-TECHSPEC-4: OPERATING A GLOBAL CACHE

4.5.5 Based on its received notifications, a Global Cache shall download discovery metadata records from WIS nodes or other Global Caches and store them for a minimum duration of 24 hours, until receipt of a notification requesting deletion of those discovery metadata records.

...

4.6 WIS-TECHSPEC-5: OPERATING A GLOBAL DISCOVERY CATALOGUE

4.6.10 A Global Discovery Catalogue shall create an archive of all valid discovery metadata records at least once per day. This archive resource shall be openly accessible.

4.6.11 A Global Discovery Catalogue shall publish notifications to a Message Broker indicating the availability of a discovery metadata archive resource. Notifications shall include the URL for downloading the archive resource from the Global Discovery Catalogue.

...

4.7 WIS-TECHSPEC-6: MANAGING OPERATIONS OF THE WIS

~~4.7.4 Specialized incident management portals fulfilling the requirements prescribed in the Technical Regulations shall collect and display metrics to support data management within a particular domain or programme.~~

4.7.4~~5~~ GISCs with the support of Global Services shall coordinate the incident management process described in the Guidance on Technical Specifications of WIS 2.0 Guide to WIS (WMO-No. 1061), Volume II to satisfy the required service level.

...

PART V. WIS DISCOVERY METADATA

5.1 GENERAL

5.1.2 The WIS2 Core Metadata Profile (WCMP2) for discovery metadata is specified in Appendix F.

~~Note: More information on discovery metadata is provided in the Guidance on Technical Specifications of WIS 2.0.~~

...

PART VI. INFORMATION MANAGEMENT

6.1 MANAGING INFORMATION AND COMMUNICATION TECHNOLOGY OPERATIONS

~~6.1.1 WIS centres should participate in the WIS IT Security Incident Response Process specified in the Guide to the WMO Information System (WMO-No. 1061), Part VII, Appendix F to the extent permitted by national regulations, policies and procedures.~~

6.1.1~~2~~ All Members should follow the guidance provided in ~~Part VI of~~ the *Guide to the WMO Information System* (WMO-No. 1061), Volume II and use appropriate information management processes to generate, share, use, archive and dispose of information supporting WMO and partner organization programmes.

~~6.1.3 Information management practices shall include: documentation, governance, quality assurance and competency development.~~

~~6.1.4 Members should apply the guidance provided in the Guidance on Technical Specifications of WIS 2.0.~~

....

2. Addition of Appendix D: WIS2 Topic Hierarchy

APPENDIX D: WIS2 TOPIC HIERARCHY

The normative provisions in this standard are denoted by the <http://wis.wmo.int/spec/wth/1> URI. All requirements in this document are denoted by partial URIs which are relative to this base and examples are represented with shaded text.

1. REQUIREMENTS CLASS "CORE"

URI	http://wis.wmo.int/spec/wth/1/req/core
Target type	Topic classification
Dependency	MQTT v5.0
Dependency	MQTT v3.1.1
Pre-conditions	Topics conform to Topic Name requirements of MQTT

1.1 Overview

The WIS2 Topic Hierarchy (WTH) is composed of primary topics (levels 1-7) and sub-discipline specific topics (levels 8 and beyond).

The primary topics apply to all data and resources in WIS. They are relational, meaning that any combination of the values in each level can be used to construct a topic applicable to a notification. See table below.

The sub-discipline topics are proposed by domain experts and user communities. These levels are a hierarchical representation of the dataset and the number of levels in this part may vary according to the requirements of various domains.

The representation is encoded as a simple text string of values in each topic level separated by a `/`.

Examples

`origin/a/wis2/ca-eccc-msc/data/core/weather/surface-based-observations/synop`

`origin/a/wis2/ca-eccc-msc/data/recommended/atmospheric-composition/experimental/space-based-observation/geostationary/solar-flares`

Table. WTH primary topic levels

Level	Name	Description
1	channel	Location of where the data originates from (data providers are <code>origin</code> and global services <code>cache</code>)
2	version	Alphabetical version of the topic hierarchy, currently: <code>a</code>
3	system	Fixed value of <code>wis2</code> for WIS2
4	centre-id	Acronym as specified by member and endorsed by the PR of the country and WMO
5	notification-type	WIS2 notification types (<code>data</code> or <code>metadata</code>)
6	data-policy	Data policy as defined by the WMO Unified Data Policy (<code>core</code> and <code>recommended</code>)
7	earth-system-discipline	Seven high-level categories as defined by the WMO Unified Data Policy, Annex 1: (<code>atmospheric-composition</code> , <code>climate</code> , <code>cryosphere</code> , <code>hydrology</code> , <code>ocean</code> , <code>space-weather</code> , or <code>weather</code>)

1.2 Publishing

For maximum utility and efficient management of topics, it is recommended that **data** and **metadata** are published to a detailed level of the topic hierarchy. This helps avoid the "pollution" of messages under the primary topics. Note that each discipline has a sub-discipline topic named **experimental** for publication to provisional topics.

Requirement 1	/req/core/publishing
A	Data shall not be published with a topic that is not defined in this specification.
B	Data shall be published to at least the level of the sub-discipline topic (level 8 or beyond).
C	Metadata shall be published to at least the level of the notification type (metadata).

Recommendation 1	/rec/core/publishing
A	The topic experimental should be used as a temporary approach until a given sub-discipline topic is approved.

Permission 1	/per/core/publishing
A	Metadata may be published at any level at or below the notification type (metadata).
B	Data may be published with the experimental topic and include any sub-discipline topics which are not yet approved.

1.3 Management

The primary levels and sub-discipline specific levels are managed differently to maintain stability and allow for flexibility.

Requirement 2	/req/core/management
A	Primary topics (levels 1 to 7) shall be determined by WMO.
B	Sub-discipline topics (level 8 and beyond) shall be proposed by domain experts and user communities.
C	Sub-discipline topics (level 8 and beyond) shall be defined using a hierarchical approach.
D	Sub-discipline topics (level 8 and beyond) shall be coordinated and integrated by WMO.

Requirement 3	/req/core/releasing
A	The addition of a new centre identifier shall trigger an immediate stable release of WTH updates, which is not required to align with the WMO fast-track approval procedure.
B	Immediate stable releases shall only contain changes resulting from a new value in the centre-id topic.
C	Updates to the primary levels and other major revisions will go through the WMO standard procedure.
D	Updates to the sub-discipline topics (level 8 and beyond) will go through the WMO fast-track approval procedure.

1.4 Versioning

The topic hierarchy version helps data providers and data consumers with change management and transition in relation to updates.

Requirement 4	/req/core/versioning
A	A minor version shall not result in any changes to the version level.
B	A major version shall result in a change to the version level (for example, a becomes b).
C	Removal of a topic at any level shall result in a major version update.
D	Renaming of a topic at any level shall result in a major version update.
E	A change in the structure of the topic hierarchy shall result in a major version update.
F	A renaming or removal in the WMO Notification Message encoding shall result in a major version update.
G	A new topic shall not result in any version update.
H	A new centre identifier shall not result in any version update.

1.5 Conventions

All levels of the topic hierarchy are defined in a consistent manner to support a normalized and predictable structure.

Requirement 5	/req/core/conventions
A	Topic level definitions shall be lowercase.
B	Topic level definitions shall be encoded in IRA T.50 .
C	Topic level definitions shall not utilize dots (.).
D	Topic level definitions shall utilize dashes (-) to separate words (such as sea-ice).
E	All topic level definitions at a given level shall be unique.
F	The topic structure levels imply a fixed sequence and shall not be re-ordered.

1.6 Centre identification

The centre identifier ([centre-id](#)) is an acronym as specified by the member and endorsed by the PR of the country and WMO. It is a single identifier comprised of a top-level domain (TLD) and centre name. It represents the data publisher, distributor or issuing centre of a given dataset, data product, data granule or other resource.

Requirement 6	/req/core/centre-id
A	A centre identifier shall not be used by more than one WIS2 Node or Global Service.
B	A centre identifier shall be formatted as tld-centre-name , where: - The tld string is based on a TLD as defined by IANA for the relevant country or international organization - The centre-name string is based on a centre name
C	The test TLD shall be used only for WIS internal system testing purposes.

Recommendation 2	/rec/core/centre-id

A	Organizations operating with a gov or similar TLD should use the TLD based on their country to define the TLD component of their centre identifier.
B	International organizations operating with int , org or similar TLD should reuse these to define the TLD component of their centre identifier.
C	Organizations wishing to test their WIS2 Node or Global Service may provide the -test suffix to their centre identifier (for example, int-org1-test).

Permission 2	/per/core/centre-id
A	A centre identifier's centre-name component may contain dashes.
B	Larger organizations providing multiple centres may use dashes in the centre-name component to further delineate a centre function (for example, int-org1-nwp , int-org1-ozone).
C	A centre providing a WIS service may further qualify the function within the centre-name component (for example, int-org1-global-cache).

2. WIS2 TOPIC HIERARCHY RESOURCES

2.1 WMO Codes Registry

Level	Topic	URI
1	channel	https://codes.wmo.int/wis/topic-hierarchy/channel
2	version	https://codes.wmo.int/wis/topic-hierarchy/version
3	system	https://codes.wmo.int/wis/topic-hierarchy/system
4	centre-id	https://codes.wmo.int/wis/topic-hierarchy/centre-id
5	notification-type	https://codes.wmo.int/wis/topic-hierarchy/notification-type
6	data-policy	https://codes.wmo.int/wis/topic-hierarchy/data-policy
7	earth-system-discipline	https://codes.wmo.int/wis/topic-hierarchy/earth-system-discipline
8	atmospheric-composition	https://codes.wmo.int/wis/topic-hierarchy/atmospheric-composition
	climate	https://codes.wmo.int/wis/topic-hierarchy/climate
	cryosphere	https://codes.wmo.int/wis/topic-hierarchy/cryosphere
	hydrology	https://codes.wmo.int/wis/topic-hierarchy/hydrology
	ocean	https://codes.wmo.int/wis/topic-hierarchy/ocean
	space-weather	https://codes.wmo.int/wis/topic-hierarchy/space-weather
	weather	https://codes.wmo.int/wis/topic-hierarchy/weather

2.2 WMO schemas server

A zipped directory of all topics is published at <https://schemas.wmo.int/wth/a>. This bundle can be used by tools and applications wishing to browse or validate topic structures.

3. Addition of Appendix E: WIS2 Notification Message

APPENDIX E: WIS2 NOTIFICATION MESSAGE

WIS2 Notification Message (WNM) is an extension of the OGC API - Features standard and shall be encoded in GeoJSON. The normative provisions in this standard are denoted by the base URI (<http://wis.wmo.int/spec/wnm/1>) and requirements are denoted by partial URIs relative to this base. Property names, values and examples are represented with shaded text in this document.

1. REQUIREMENTS CLASS "CORE"

URI	http://wis.wmo.int/spec/wnm/1/req/core
Target type	Notification metadata
Dependency	The JavaScript Object Notation (JSON) Data Interchange Format (IETF RFC8259 (2017))
Dependency	JSON Schema (2022)
Dependency	The GeoJSON Format (IETF: RFC-7946 (2016))
Dependency	OGC API - Features - Part 1: Core corrigendum (OGC: OGC 17-069r)
Pre-conditions	The record conforms to GeoJSON (RFC7946)

1.1 Overview

The table below provides an overview of the set of properties that may be included in a WNM.

Table. WNM core properties

Property	Requirement	Description
id	required	A universally unique identifier of the message (see Identifier)
type	required	A fixed value denoting the record as a GeoJSON Feature (see GeoJSON compliance)
version	required	Version of message specification (see Version)
geometry	required	Geospatial location associated with the data or metadata (see Geometry)
properties.pubtime	required	The date and time of when the notification was published (see Properties / Publication Time)
properties.data_id	required	Unique identifier of the data as defined by the data producer (see Properties / Data Identification)
properties.metadata_id	optional	Identifier for associated discovery metadata record to which the notification applies (see Properties / Metadata identification)
properties.producer	optional	Identifies the provider that initially captured and processed the source data, in support of data distribution on behalf of other Members (see Properties / Producer)
properties.datetime	optional	Identifies the reference date and time of the data instance to which the notification is relayed (see Properties / Temporal description)
properties.start_datetime	optional	Identifies the start date and time of the data being published (see Properties / Temporal description)
properties.end_datetime	optional	Identifies the end date and time of the data being published (see Properties / Temporal description)
properties.cache	optional	Indicates whether the data in the notification should be cached (if not specified, the default value is true) (see Properties / Cache)

properties.integrity	optional	Specifies a checksum to be applied to the data to ensure that the download is accurate (see Properties / Integrity)
properties.content	optional	Used to embed small products inline within the message (see Properties / Content)
links	required	Online linkages for data retrieval or additional resources associated with the dataset (see Links)

1.2 Message size

The WIS2 Notification Message allows for the transmission of messages in a compact manner and includes the ability to embed content inline as required (see [Properties / Content](#)).

Requirement 1	/req/core/message_size
A	A WNM message shall not exceed 8192 bytes.

1.3 GeoJSON compliance

The WIS2 Notification Message schema is based on *GeoJSON* (RFC7946) and its associated information model. Compliant messages are therefore compliant with *GeoJSON*.

Requirement 2	/req/core/validation
A	Each WNM shall validate without error against the WNM schema.
B	Each WNM shall provide <code>id</code> , <code>type</code> , <code>geometry</code> and <code>properties</code> properties for GeoJSON compliance (see 2.2 WMO schemas server)
C	Each WNM record <code>type</code> property shall be set to a fixed value of <code>Feature</code> for GeoJSON compliance.

1.4 Identifier

A universally unique identifier of the message using the UUID standard ([RFC4122](#)). The identifier is generated by the originator of the message. It provides the anti-loop feature that is needed to ensure that the message will be seen once by all Global Brokers. It remains the same throughout the lifetime of the message in the WIS2 ecosystem.

The [Properties / Data Identification](#) is retained to ensure traceability and consistency of the same resource.

Example

```
"id": "31e9d66a-cd83-4174-9429-b932f1abe1be"
```

Requirement 3	/req/core/identifier
A	The <code>id</code> property shall be a Universally Unique Identifier (UUID).

1.5 Version

The `version` property provides the version of WNM that the message conforms to.

Requirement 4	/req/core/version
A	A WNM shall provide information on version conformance via the <code>version</code> property.
B	The <code>version</code> property shall be fixed to <code>v1.0</code> for this version of the specification.

1.6 Geometry

The type of geometry in a notification message may be `Point` or `Polygon`. It can also be type `null` if the geometry cannot be derived.

Example. Point

```
{
  ...
  "geometry": {
    "type": "Point",
    "coordinates": [
      6.146255135536194,
      46.223296618227444
    ]
  }
  ...
}
```

Example. Point with elevation

```
{
  ...
  "geometry": {
    "type": "Point",
    "coordinates": [
      6.146255135536194,
      46.223296618227444,
      392
    ]
  }
  ...
}
```

Example. Polygon

```
{
  ...
  "geometry": {
    "type": "Polygon",
    "coordinates": [
      [
        [-7.75,40.43],
        [-7.75,78.46],
        [71.91,78.46],
        [71.91,40.43],
        [-7.75,40.43]
      ]
    ]
  }
  ...
}
```

Example. null

```
{
    ...
    "geometry": null
    ...
}
```

Requirement 5	/req/core/geometry
A	A WNM record shall provide ONE geometry property to convey the geospatial properties of a notification using a geographic coordinate reference system (World Geodetic System 1984 [WGS 84]) and longitude and latitude decimal degree units.
B	The <code>geometry</code> property shall only provide one of a <code>Point</code> or <code>Polygon</code> geometry, or a <code>null</code> value when a geometry value is unknown or cannot be determined.

Permission 1	/per/core/geometry
A	The <code>geometry</code> property may provide a third element (height) as per clause 4 of the GeoJSON specification.

1.7 Properties / Publication Time

The `pubtime` property identifies the date/time when the notification was first posted or published by the originator. The date/time is encoded in RFC3339 format with the UTC timezone (Z).

The publication date/time is critical for subscribers to prevent message loss in providing awareness of how far behind the publisher they may be.

The `pubtime` property is also valuable for change detection as part of updates and deletion notifications.

Ensuring `pubtime` is properly managed for updates and deletions is important for data and metadata download workflows. For example, an out-of-date `pubtime` can lead to errors for clients when managing updates or deletions in their local copies of data. An update with newer `pubtime` and identical `datetime` indicates a newer version of the data or metadata.

```
"properties": {
    ...
    "pubtime": "2022-03-20T04:50:18.314854383Z"
    ...
}
```

Requirement 6	/req/core/pubtime
A	A WNM shall provide a <code>properties.pubtime</code> property.
B	The <code>properties.pubtime</code> property shall be in RFC3339 format.
C	The <code>properties.pubtime</code> property shall be in UTC timezone.
D	The <code>properties.pubtime</code> property shall be set to the current time by the original publisher of the notification.
E	The <code>properties.pubtime</code> property shall be set to the current time also for notifications about updates or deletions.
F	The <code>properties.pubtime</code> property shall not be modified by any intermediaries.

1.8 Properties / Data Identification

The `data_id` property uniquely identifies the data described by the notification and is defined by the data producer. A data producer may use an identification scheme of their choice.

Example.

```
"properties":
  ...
  "data_id": "wis2/ma-marocmeteo/data/core/weather/surface-based-
observations/synop/WIGOS_0-504-1-60288_20240210T130000"
  ...
}
```

Requirement 7	/req/core/data_id
A	A WNM shall provide a <code>properties.data_id</code> property.
B	The <code>properties.data_id</code> property shall be unique within the scope of the relevant dataset.

Recommendation 3	/rec/core/data_id
A	The <code>properties.data_id</code> property should NOT use an opaque id. It should be encoded with meaningful values to support client-side filtering.

Permission 1	/per/core/data_id
A	The <code>properties.data_id</code> property may contain a valid WIS2 topic, without the channel and version.

1.9 Properties / Metadata identification

The `metadata_id` property uniquely identifies the associated discovery metadata record. This property is an important linkage between a WCMP2 dataset discovery metadata record and the related data notifications. The inclusion of this property allows a subscriber to consult additional documentation of the dataset and understand the access control applied to the data.

Example.

```
"properties":
  ...
  "metadata_id": "urn:wmo:md:can:eccc-msc:observations.swob"
"urn:wmo:md:ca-eccc-msc:observations.swob"
  ...
}
```

Recommendation 4	/rec/core/metadata_id
A	A WNM should provide a <code>properties.metadata_id</code> property that identifies the associated WCMP2 dataset discovery metadata record. See requirement for metadata identification in WCMP2.

1.10 Properties / Producer

The `producer` property identifies the provider that initially captured and processed the source data, in support of data distribution on behalf of other Members.

Example.

```
"properties": {
  ...
  "producer": "fra"
  ...
}
```

Recommendation 5	/rec/core/producer
A	A WNM should provide a <code>properties.producer</code> property when publishing data on behalf of other Members.

1.11 Properties / Temporal description

The `datetime` property identifies the date and time of the data (for example, when a measurement was observed). When a data or metadata is updated or deleted, this value should identify the original data or metadata, which can be significantly different from the current time.

The `start_datetime` and `end_datetime` properties identify a temporal extent (for example, the start and end times of an NWP forecasting period).
All dates and times are encoded in RFC3339 format with the UTC timezone (`Z`).
A `null` value can also be used if a temporal description of the data cannot be derived.

Example. Temporal instant

```
"properties": {
  ...
  "datetime": "2022-03-20T04:45:00Z"
  ...
}
```

Example. Temporal extent

```
"properties": {
  ...
  "start_datetime": "2022-03-20T04:45:00Z",
  "end_datetime": "2022-03-22T04:45:00Z"
  ...
}
```

Example. No temporal description

```
"properties": {
  "datetime": null,
  ...
}
```

Requirement 8	/req/core/temporal

A	A WNM shall provide a temporal description by either a <code>properties.datetime</code> property or both the <code>properties.start_datetime</code> and <code>properties.end_datetime</code> properties.
B	The temporal description shall be in RFC3339 format.
C	The temporal description shall be in the UTC timezone.
D	The temporal description shall be set to <code>null</code> (using only <code>properties.datetime</code>) when a temporal description cannot be derived.

1.12 Properties / Cache

All `Core` data, by default, is cached by Global Cache services [as described in the Guide to the WMO Information System \(WMO-No. 1061\)](#).

However, a data producer can use the `properties.cache` value to request Global Cache services to not cache their `core` data granule.

Example. Specifying data not to be cached

```
"properties": {
  "cache": false,
  ...
}
```

Permission 2	/per/core/cache
A	A WNM may specify whether the data should be cached via the <code>properties.cache</code> property.

1.13 Properties / Integrity

For data verification, it is recommended to include data integrity information via the `integrity` property. Providing this information will allow data consumers to ensure that a given data granule has not been corrupted during download.

The `method` property provides a format of the hashing method used to enable an integrity check of the data. The preferred values are `sha256`, `sha384`, `sha512`, `sha3-256`, `sha3-384`, and `sha3-512`.

The `value` property provides the result of the hashing method in base64 encoding.

Example.

```
"properties": {
  ...
  "integrity": {
    "method": "sha512",
    "value": "CPvTLiOfYRgfl3YNF/KKElwamwvLQwnzd96VnF2WoYuuH+hVIbwFSPQH
Hd/qa/fNVUBckviC5/HZs3Nx2jXEsA=="
  }
  ...
}
```

Recommendation 6	/rec/core/integrity
A	A WNM should provide a <code>properties.integrity</code> property, consisting of a <code>method</code> property identifying the hashing

method (sha256, sha384, sha512, sha3-256, sha3-384, sha3-512) and a value property of the hashing result, when it can be easily derived.

1.14 Properties / Content

The content property allows for the inclusion of data in the notification message when the encoded data length of the data, once encoded, is smaller than 4096 bytes. ~~The limit considers the data encoding. That is, if the data are encoded in a form that changes the size, the resulting size must be less than 4096 bytes.~~

The encoding property provides the character encoding of the data (UTF-8, Base64, or gzip), the gzip encoding means that the data are compressed using algorithm defined in RFC1952 and consequently converted to text using Base64 encoding.

The value property provides the data in accordance with the encoding property.

The size property provides the size, in bytes, of the data in its original unencoded form, therefore this value shall not be directly compared with the size limit.

Example.

```
"properties": {
  ...
  "content": {
    "encoding": "utf-8",
    "value": "encoded bytes from the file",
    "size": 457
  }
  ...
}
```

Requirement 9	/req/core/content
A	For data whose resulting size in the encoded form is greater than 4096 bytes, notifications shall not provide inline via `+properties.content.value+`. Note that the encoding may both enlarge the data size (for example when binary data, such as BUFR, is Base64 encoded), as well as reduce the size (for example, when XML data are compressed with `gzip`).

Recommendation 7	/rec/core/content
A	A WNM should provide a content property, consisting of an encoding property (either utf-8, base64, or gzip), a value property of the data, as well as a size property with the length of the data.

Permission 3	/per/core/content
A	For data whose resulting size (after possible compression) is less than 4096 bytes, notifications may provide the data inline via properties.content.value.

1.15 Links

The links array property consists of one or more objects providing URLs to access data.

Each link object provides:

- an **href** property with a fully qualified link to access the data
- a **rel** property providing an [IANA link relation](#) or [WIS link relation](#) describing the relationship between the link and the message
- a **type** property providing the media type of the data
- a **length** property providing the length (in bytes) indicating the size of the data
- a **security** property providing a description of the access control mechanism applied (for example, recommended data with restrictions)

Links are used to communicate new data or metadata notifications. Links can also communicate when data or metadata has been deleted or invalidated.

Example. Canonical link

```
"links": [{
  "href": "https://example.org/data/4Pubsub/92c557ef-d28e-4713-91af-2e2e7be6f8ab.bufr4",
  "rel": "canonical",
  "type": "application/x-bufr"
}]
```

Example. Multiple links

```
"links": [{
  "href": "https://example.org/data/4Pubsub/92c557ef-d28e-4713-91af-2e2e7be6f8ab.bufr4",
  "rel": "canonical",
  "type": "application/x-bufr"
}, {
  "href": "https://example.org/oapi/collections/my-dataset/items/my-data-granule",
  "rel": "item",
  "type": "application/json"
}]
```

Requirement 10	/req/core/links
A	A WNM shall provide a links array property.
B	The links array property shall contain at least one link with, at a minimum, the href and rel properties.
C	The links for core data shall not require further action in order to download the resource.
D	The links shall be HTTP, HTTPS, FTP or SFTP.
E	For new data and metadata notifications, the links array property shall provide at least one link with an IANA link relation of canonical to clearly identify the preferred access link.

F	For data or metadata update notifications, the links array property shall provide at least one link with a link relation of update to clearly identify the preferred access link.
G	For data or metadata deletions, the links array property shall provide at least one link with a link relation of deletion to clearly identify data which has been deleted or removed.

Recommendation 8	/rec/core/links
A	A WNM should provide links using secure protocols such as HTTPS and SFTP, with HTTPS being the preferred option.
B	The link property should provide a length property to communicate the size of a given data download in advance of a data download workflow when the size of the data is known or can be easily derived.
C	The link relation of deletion should NOT be used for communicating a rolling data archive.

Permission 4	/per/core/links
A	A WNM links array property may provide link objects which reference APIs or Web Accessible Folders (WAF).

1.15.1 Access control

For recommended data, WNM links may also provide links to resources that implement access control in support of authentication and authorization. In secure data use cases, a user needs to be able to detect access-controlled data as part of data discovery and evaluation. The example demonstrates how to express access control using HTTP basic authentication for a given data access service.

Example. Access controlled link

```
"links": [
  {
    "rel": "data",
    "type": "application/json",
    "title": "link to WAF endpoint",
    "href": "https://example.org/data/secure-data",
    "security": {
      "default": {
        "type": "http",
        "scheme": "basic",
        "description": "Please contact the data provider for accessing this secured resource."
      }
    }
  }
]
```

1.16 Additional properties

A WIS2 Notification Message can be extended as required for organizational purposes by adding properties (of any type) in the message. Additional properties do not break compliance with this specification.

Example.

```

"properties":
  ...
  "_comment":
    "validationErrors":
      "error
      "error
    ]
  }
  ...
}

```

Permission 5	/per/core/additional_properties
A	A WNM may provide additional properties of any type in any part of the document as needed.

2. WIS2 NOTIFICATION MESSAGE RESOURCES

2.1 WMO Codes Registry

- <http://codes.wmo.int/wis/link-type> ~~<http://codes.wmo.int/wis/link-relations>~~

2.2 WMO schemas server

Validation, examples and other resources are published at <https://schemas.wmo.int/wnm>.

4. Addition of Appendix F: WMO Core Metadata Profile

APPENDIX F: WMO CORE METADATA PROFILE (VERSION 2)

WMO Core Metadata Profile (WCMP) is an extension of the OGC API - Features standard and shall be encoded in GeoJSON. The normative provisions in this standard are denoted by the base URI (<http://wis.wmo.int/spec/wcmp/2>) and requirements are denoted by partial URIs relative to this base. Property names, values and examples are represented with shaded text in this document.

1. REQUIREMENTS CLASS "CORE"

URI	http://wis.wmo.int/spec/wcmp/2/req/core
Dependency	The JavaScript Object Notation (JSON) Data Interchange Format (IETF RFC8259 (2017))
Dependency	JSON Schema (2022)
Dependency	The GeoJSON Format (IETF: RFC-7946 (2016))
Dependency	OGC API - Features - Part 1: Core corrigendum (OGC: OGC 17-069r)
Pre-conditions	The record conforms to OGC API - Records - Core: Part 1: Requirements Class: Record Core

1.1 Overview

The table below provides an overview of the set of properties that may be included in a WCMP record.

Table. WCMP record core properties

Property	Requirement	Description
id	required	A unique identifier of the dataset (see Identifier)
type	required	A fixed value denoting the WCMP record as a GeoJSON <code>Feature</code> (see Validation)
conformsTo	required	The version of WCMP associated that the record conforms to (see Conformance)
properties.type	required	The resource type described by the WCMP record (see Properties / Type)
properties.title	required	A human-readable name of the dataset (see Properties / Title)
properties.description	required	A free-text summary description of the dataset (see Properties / Description)
properties.keywords	optional	Keywords, tags or key phrases (see Properties / Keywords)
properties.themes	required	Classifiers, categories and controlled vocabularies (see Properties / Themes)
geometry	required	Geospatial location associated with the dataset, in a geographic coordinate reference system (see Geospatial extent)
time	required	Temporal extent associated with the dataset (see Temporal extent)
additionalExtents.spatial	optional	Additional geospatial extents in other coordinate reference systems (see Additional geospatial extents)
additionalExtents.temporal	optional	Additional time instants or periods (see Additional temporal extents)
properties.contacts	required	Contact information for the dataset (see Properties / Contacts)
properties.version	optional	Version or edition of the dataset (see Properties / Version)
properties.externalIds	optional	Persistent identifiers or handles for the dataset (see Properties / Persistent identifiers)
properties.created	required	The date that the WCMP record was created (see Properties / Record creation date)
properties.updated	optional	The date that the WCMP record was updated (see Properties / Record update date)
properties.status	optional	The operational status of the dataset (see Properties / Status)
properties.wmo:dataPolicy	conditional	Classification code of <code>core</code> or <code>recommended</code> based on the WMO Unified Data Policy . Required for datasets (see Properties / WMO data policy)
properties.rights	optional	A statement that concerns all rights not addressed by the license such as a copyright statement (see Properties / WMO data policy)
links	required	Online linkages to data retrieval or additional resources associated with the dataset (see Links and distribution information)
linkTemplates	optional	Online link templates for dynamic / API access (see Templated links)
properties.*	optional	Additional properties as needed (see Additional properties)

1.2. WCMP record representation

WCMP record can be represented in various ways internally, in WIS systems and software tools, but its external representation is GeoJSON.

Recommendation 1	/rec/core/media_type
A	The media type assigned to a WCMP record, when transported through a protocol that supports it, should be <code>application/geo+json</code> .

1.3 Validation

The WCMP record schema is based on *OGC API - Records - Part 1: Core: Requirements Class: Record Core* schema and the associated information model. WCMP records compliant with WCMP schema are therefore compliant with the *OGC API - Records* record schema.

Requirement 1	/req/core/validation
A	Each WCMP record shall validate without error against the WCMP schema.
B	Each WCMP record shall provide <code>id</code> , <code>type</code> , <code>geometry</code> and <code>properties</code> properties for GeoJSON compliance.
C	The <code>type</code> property shall be set to a fixed value of <code>Feature</code> for GeoJSON compliance.

1.4 Identifier

The `id` property is a unique identifier of the dataset. A record identifier is essential for querying and identifying records within the GDC.

Example

```
"id": "urn:wmo:md:ca-eccc-msc:observations.swob"
```

Requirement 2	/req/core/identifier
A	A WCMP record SHALL provide an identifier via the <code>id</code> property.
B	The <code>id</code> property SHALL have the following notation: ~~<code>urn:x-wmo:md:{centre_id}:{local_identifier}</code>~~ <code>Urn:wmo.md:{centre_id}:{local_identifier}</code>
C	The <code>centre_id</code> SHALL be based on the associated vocabulary specified in the WIS topic hierarchy .
D	The <code>id</code> property SHALL include a local identifier as defined by the data publisher. The local identifier SHALL NOT have spaces or special or accented characters.

Permission 1	/rec/core/identifier
A	The local identifier may also have colons (:) as required by the data publisher.

1.5 Conformance

The `conformsTo` property identifies the version of the WCMP standard that the metadata record conforms to. Conformance identification is valuable for version detection and handling of content.

Example

```
"conformsTo":
  "http://wis.wmo.int/spec/wcmp/2/conf/core"
]
```

Requirement 3	/req/core/conformance
A	A WCMP record shall provide information on conformance via the OARec record <code>conformsTo</code> property.
B	The <code>`conformsTo`</code> property shall advertise conformance to WCMP.

1.6 Properties / Type

The `type` property identifies the type of resource that the metadata record describes using values from the resource type codelist. While most metadata records will be set to `dataset`, WCMP can also describe additional resources, such as services and processes.

A `dataset` is the primary granularity of a WCMP record describing a collection of data granules.

A `service` is an API or Web service providing a discovery, visualization, or access mechanism that operates on data.

A `process` is a workflow or execution to provide custom functionality to calculate a given output or product.

Example

```
"properties":
  ...
  "type":
  ...
}
```

`"dataset"`

Requirement 4	/req/core/type
A	A WCMP record shall provide a <code>properties.type</code> property.
B	The <code>properties.type</code> property shall be a valid code from the WIS resource type codelist.

1.7 Properties / Title

The `title` property is a human-readable name of the dataset.

Example

```
"properties":
  ...
  "title":
  ...
}
```

`"Surface weather observations"`

Requirement 5	/req/core/title
A	A WCMP record shall provide a <code>properties.title</code> property.

1.8 Properties / Description

The `description` property is a free-text summary of the dataset.

Example

```
"properties":
  ...
  "description": "Surface observations measured at the automatic and manual
stations of the Environment and Climate Change Canada and partners networks,
either for a single station or for the stations of specific provinces and
territories (last 30 days)."
  ...
}
```

Requirement 6	/req/core/description
A	A WCMP record shall provide a <code>properties.description</code> property.

1.9 Properties / Keywords

The `keywords` property is a list of keywords, tags or specific phrases associated with the resource, but are not referenced to a particular vocabulary or knowledge organization system.

Example

```
"properties":
  ...
  "keywords":
    "surface",
    "observations",
    "weather",
    "real-time"
  ...
}
```

Recommendation 1	/rec/core/keywords
A	A WCMP record should provide a <code>properties.keywords</code> property, as a list of freeform text or tags that are not based on a controlled vocabulary.

1.10 Properties / Themes

The `themes` property is a list of concepts that are referenced to a vocabulary or knowledge organization system used to classify the resource.

A theme's `scheme` property provides a remote reference to a controlled vocabulary, codelist or knowledge organization system.

A concept's `id` provides an identifier for the given concept, as well as optional `title`, `description` and `url` properties to further describe the concept as desired.

A concept's optional `url` property can provide a remote reference to a given concept (for example, to an online ontology or code registry).

A WCMP metadata record can have one or more themes.

Example. Themes object with GRIB2 codes

```
"properties":
  ...
  "themes":
    {
      "concepts":
        {
```



```

        "id": "0-0-0",
        "title": "Temperature",
        "url": "http://codes.wmo.int/grib2/codeflag/4.2/0-0-0"
      },
      {
        "id": "0-1-1",
        "title": "Relative humidity",
        "url": "http://codes.wmo.int/grib2/codeflag/4.2/0-1-1"
      },
      {
        "id": "0-2-2",
        "title": "u-component of Wind",
        "url": "http://codes.wmo.int/grib2/codeflag/4.2/0-2-2"
      },
      {
        "id": "0-2-3",
        "title": "v-component of Wind",
        "url": "http://codes.wmo.int/grib2/codeflag/4.2/0-2-3"
      }
    ],
    "scheme": "http://codes.wmo.int/grib2/codeflag/4.2"
  }
]
...
}

```

Example. Themes object with BUFR4 codes

```

"themes": [
  {
    "concepts": [
      {
        "id": "001",
        "title": "Temperature/air temperature",
        "url": "http://codes.wmo.int/bufr4/b/12/001"
      },
      {
        "id": "003",
        "title": "Dewpoint temperature",
        "url": "http://codes.wmo.int/bufr4/b/12/003"
      }
    ],
    "scheme": "http://codes.wmo.int/bufr4/b"
  }
]

```

Example. Themes object with of the earth-system-discipline from the WMO Topic Hierarchy

```

"properties": {
  ...
  "themes": [
    {
      "concepts": [
        {
          "id": "weather",
          "title": "Weather",
          "url": "http://codes.wmo.int/wis/topic-hierarchy/earth-system-

```

```

discipline/weather"
  },
  "scheme": "http://codes.wmo.int/wis/topic-hierarchy/earth-system-
discipline"
}
]
...
}

```

Requirement 7	/req/core/themes
B	A WCMP record shall provide at least one themes property.
C	Each themes property shall provide at least one concept property.
D	Each themes property shall provide a scheme property that refers to a controlled vocabulary or thesaurus.
E	A WCMP record describing a dataset shall provide a themes property identifying all applicable Earth system disciplines as defined in the WIS2 Topic Hierarchy .

Requirement 8	/req/core/themes_wis2_global_service
A	A WCMP record describing a WIS2 global service shall provide a themes property identifying all Earth system disciplines as defined in the WIS2 Topic Hierarchy .
B	A WCMP record describing a WIS2 global service shall provide a themes property identifying the service type provided.

Recommendation 2	/rec/core/granularity
A	A WCMP record should describe dataset parameters and variables as themes/concepts with an associated controlled vocabulary.

Permission 2	/per/core/themes
A	A WCMP record may provide as many themes/concepts as applicable to describe the themes of a given dataset.

1.11 Geospatial and temporal extents

1.11.1 Geospatial extent

The `geometry` property is the general bounding spatial extent of the dataset in the geographic coordinate system. Geospatial bounding extents provide a useful indicator of the location of the dataset to facilitate search and map displays in the GDC.

Examples

```

"geometry": {
  "type": "Polygon",
  "coordinates": [[
    [-142.23, 28.03],
    [-142.23, 82.56],
    [-52.16, 82.56],
    [-52.16, 28.03],
    [-142.23, 28.03]
  ]]
}

```

```
"geometry":
  "type":
  "coordinates":
}
```

```
{
  "Point",
  43.65]
}
```

```
"geometry": null
```

Requirement 9	/req/core/extent_geospatial
A	A WCMP record shall provide one <code>geometry</code> property to convey the geospatial properties of a dataset using a geographic coordinate reference system (World Geodetic System 1984 [WGS 84]) and longitude and latitude decimal degree units.
B	The <code>geometry</code> coordinates shall be integer or float data types.
C	The <code>geometry</code> property shall provide the value of <code>null</code> when geometry cannot be derived.

Recommendation 3	/rec/core/extent_geospatial_point
A	For datasets based on a geometry without a calculated area (for example, single station point), a WCMP record should provide the GeoJSON geometry as a <code>Point</code> type.

Recommendation 4	/rec/core/extent_geospatial_precision
A	Geometry coordinates should have a level of precision of at least 2 or more decimal places.

Recommendation 5	/rec/core/extent_geospatial_wis_2_global_service
A	For a WIS2 Global Service, a WCMP record should provide the GeoJSON geometry as a <code>Polygon</code> type with a WGS84 bounding geometry of <code>-180</code> (west longitude), <code>-90</code> (south latitude), <code>180</code> (east longitude), <code>90</code> (north latitude).

1.11.2 Additional geospatial extents

The `additionalExtents.spatial` property is for other geospatial extents associated with the dataset. For example, it may be useful for non-geographic data or for describing multiple sub-areas of a dataset. The `additionalExtents.spatial.bbox` property provides the ability to list one to many minimum bounding geometries for a given dataset, where:

- The minimum longitude is the westernmost coordinate of the limit of the dataset extent, expressed in longitude decimal degrees as a signed number between `-180` and `180`, less than or equal to maximum longitude.
- The minimum latitude is the southernmost coordinate of the limit of the dataset extent, expressed in latitude decimal degrees as a signed number between `-90` and `90`, less than or equal to maximum latitude.
- The maximum longitude is the easternmost coordinate of the limit of the dataset extent, expressed in longitude decimal degrees as a signed number between `-180` and `180`, greater than or equal to minimum longitude.

- The maximum latitude is the northernmost coordinate of the limit of the dataset extent, expressed in latitude decimal degrees as a signed number between -90 and 90, greater than or equal to minimum latitude.

This property also facilitates catalogue searches with geospatial predicate (within extent, etc.).

Example

```
"additionalExtents":
  "spatial":
    "bbox":
      [-142, 42, -52, 84]
    "crs": "http://www.opengis.net/def/crs/OGC/1.3/CRS84"
```

Permission 3	/per/core/extent_geospatial
A	A WCMP record may provide multiple <code>additionalExtents.spatial.bbox</code> item properties to express additional geospatial extents in other coordinate reference systems.
B	The <code>geometry</code> property may provide a third element (height) as per clause 4 of the GeoJSON specification.

1.11.3 Temporal extent

The `time` property describes the general bounding extent of the dataset and the temporal resolution.

Temporal extents provide a useful indicator of the date and time period of the dataset and facilitates temporal searching in the GDC.

In addition, the temporal resolution provides a useful indicator of the data update frequency (for example, for real-time datasets). If only times are given for the interval, it is implicitly assumed that those are recurring every day.

In cases where no time indication can be derived, it is applicable to state the value of `null`.

Examples

```
"time":
  "date": "2021-10-30"
}

"time":
  "timestamp": "2021-10-30T11:11:11Z"
}

"time":
  "interval": : ["2020-10-30", "2021-10-30"],
  "resolution": "P1D"
}

"time":
  "interval": : ["T00Z", "T23Z"],
  "resolution": "PT1H"
}
```

```
"time":
  "interval": ["2018-04-22",
  ],
}

"time": null
```

To ensure clarity, an additional human-readable explanation is given in the `properties.description`. Further time-related characteristics (for example, frequency of modifications, available data, etc.) should be added in `properties.themes`.

Some cases might be more complex due to the product’s characteristics. If necessary, further granularity can be indicated by the `additionalExtents.temporal` property (see [Additional temporal extents](#)).

Example. Complex time indication

```
"time":
  "interval": ["2018-04-22",
  ],
  "additionalExtents":
    "temporal":
      "interval": [
        "T00Z",
        "PT180H"
      ],
      [
        "T12Z",
        "PT180H"
      ]
    ],
    "resolution": "PT6H",
    "trs": "http://www.opengis.net/def/trs/ISO-8601"
  }
}
```

Example. Complex time indication further described with themes property

```
"properties":
  ...
  "description": "ICON-EPS 0.5 deg x 0.5 deg regular lat/lon grid, up to +180h every 6h, runs 00/12 UTC, various parameter, various level, various threshold",
  "themes":
    {
      "concepts":
        { "id": "continual" }
    },
    "scheme":
      "https://standards.iso.org/iso/19139/resources/gmxCodelists.xml#MD_FrequencyCode"
  }
}
```

Requirement 10	/req/core/extent_temporal

A	A WCMP record shall provide one <code>time</code> property using the Gregorian calendar.
B	The <code>time</code> property shall provide either one <code>date</code> , <code>timestamp</code> , <code>interval</code> , or the value of <code>null</code> when a conformant time cannot be derived.
C	All non-null <code>time</code> values shall be valid ISO8601 representations or <code>..</code> for an open-ended extent.

Recommendation 6	/rec/core/extent_temporal
A	For datasets with known or discrete intervals, a WCMP record should provide the temporal resolution (<code>time.resolution</code>) as a valid ISO 8601 duration (for example, P1D).
B	For complex temporal extents, a WCMP record should also provide a human-readable explanation in <code>properties.description</code> to promote clarification and unambiguity.
C	To distinguish maintenance or update frequency, those should be included in <code>properties.themes</code> .

Recommendation 7	/rec/core/extent_service
A	For WCMP records describing a service or API, a <code>time</code> value of <code>null</code> may be provided.

1.11.4 Additional temporal extents

The `additionalExtents.temporal` property is for describing other temporal extents associated with the dataset. For example, it may be useful to represent multiple time instances or to identify other temporal reference systems. Temporal extents can be fully bound or open in either direction. An `additionalExtents.temporal.resolution` property is able express the temporal granularity at which a given dataset's data is measured, generated, or reported.

Example

```
"additionalExtents":
  "temporal":
    "interval":
      [
        "T00Z",
        "PT180H"
      ],
      [
        "T12Z",
        "PT180H"
      ]
    ],
    "resolution": "PT6H",
    "trs": "http://www.opengis.net/def/trs/ISO-8601"
  }
```

Permission 4	/per/core/extent_temporal

A	A WCMP record may provide multiple <code>additionalExtents.temporal</code> item properties to express additional temporal extents in other temporal reference systems.

1.12 Properties / Contacts

The `contacts` property is the information associated with one or more responsible parties of the resource.

Example. Contacts object with all contact details

```
"properties": {
  ...
  "contacts": [{
    "identifier": "ECCC",
    "organization": "Government of Canada; Environment and Climate Change
Canada; Meteorological Service of Canada",
    "name": "National Inquiry Response Team",
    "phones": [{
      "value": "+18199972800"
    }],
    "emails": [{
      "value": "enviroinfo@ec.gc.ca"
    }],
    "addresses": [{
      "deliveryPoint": [ "77 Westmorland Street, suite 260" ],
      "city": "Fredericton",
      "administrativeArea": "NB",
      "postalCode": "E3B 6Z4",
      "country": "Canada"
    }],
    "links": [{
      "href": "https://example.org/about",
      "rel": "about",
      "type": "text/html"
    }],
    "contactInstructions": "email",
    "roles": [ "producer", "host" ]
  ]
  ...
}
```

Example. Contacts object with URL to the relevant homepage

```
"properties": {
  ...
  "contacts": [{
    "organization": "Government of Canada; Environment and Climate Change
Canada; Meteorological Service of Canada",
    "links": [{
      "href": "https://example.org/about",
      "rel": "about",
      "type": "text/html"
    }],
    "roles": [ "producer" ]
  ]
}
```

```
}]
}
```

Requirement 11	/req/core/contacts
A	A WCMP record shall provide at least one contact via the <code>properties.contacts</code> property.
B	The <code>properties.contacts</code> shall provide an <code>organization</code> property.
C	The <code>roles</code> property, when specified, shall provide a role type from the WCMP role type codelist.

Permission 5	/per/core/contacts
A	The <code>properties.contacts</code> property may provide more than one contact via multiple objects or a single contact object with multiple roles.

1.13 Properties / Version

The `version` property is the version or edition of the dataset. Datasets may be versioned by an organization, for example, the version of an NWP model or a processing chain/workflow, and data providers can make this information available when there are multiple versions of a dataset over time.

Example

```
"properties":
  ...
  "version": "0.1.0"
  ...
}
```

Permission 6	/per/core/version
A	A WCMP record may provide a <code>properties.version</code> property to describe the version of a given dataset.

1.14 Properties / Persistent identifiers

The `externalIds` property is a persistent (or handle) identifier used to provide a long-lasting reference to a digital resource. Persistent identifiers are commonly used for scientific publications and datasets.

Examples of persistent identifiers include, but are not limited to:

- Digital Object Identifiers ([DOI](#))
- Archival Resource Key ([ARK](#))
- [Handle](#)

Example. Persistent identifiers

```
"properties":
  ...
  "externalIds":
    "scheme": "https://doi.org",
    ...
}
```



```

    "value": "10.14287/10000001"
  },
  "scheme": "https://handle.net",
  "value": "2381/12775"
},
{
  "scheme": "https://arks.org",
  "value": "ark:/13030/tf5p30086k"
}]
...
}

```

Example. Online citation

```

"links": [
  {
    "rel": "cite-as",
    "title": "Cite as: WMO/GAW Ozone Monitoring Community, World Meteorological
Organization-Global Atmosphere Watch Program (WMO-GAW)/World Ozone and
Ultraviolet Radiation Data Centre (WOUDC) [Data]. Retrieved [YYYY-MM-DD], from
https://woudc.org. A list of all contributors is available on the website.
doi:10.14287/10000004",
    "type": "text/html",
    "href": "https://dx.doi.org/10.14287/10000004"
  }
]

```

Recommendation 8	/rec/core/pids
A	A WCMP record should provide persistent identifier references via items in the <code>properties.externalIds</code> array property, where the value of <code>scheme</code> is based on an established persistent identifier scheme (such as <code>https://doi.org</code> , <code>https://arks.org</code> , <code>https://handle.net</code> , etc.), and the <code>value</code> property is the persistent identifier (for example, <code>https://dx.doi.org/10.14287/10000001</code>).

Permission 7	/per/core/pids
A	A WCMP record may provide a persistent identifier to cite research or resource identification using a persistent identifier scheme/framework.
B	A WCMP record may provide a persistent identifier as a link object with <code>rel=cite-as</code> if there is an online citation or reference.

1.15 Properties / Record creation date

The `created` property is a single date that the WCMP metadata record was created. Note that this date is not the start or end time of a given dataset. See [Temporal extent](#) for more information on defining dataset temporal extents.

Example

```

"properties": {
  ...
  "created": "2021-06-12T23:45:24Z"
  ...
}

```

Requirement 12	/req/core/record_creation_date
A	A WCMP record shall provide a single <code>properties.created</code> property.
B	The <code>properties.created</code> property shall not be repeated or used to document change history.

1.16 Properties / Record update date

The `updated` property is the date that the WCMP metadata record was last updated. Note that this date is not the start or end time of a given dataset. See [Temporal extent](#) for more information on defining dataset temporal extents.

Example

```
"properties": {
  ...
  "updated": "2022-06-12T18:52:39Z"
  ...
}
```

Recommendation 9	/rec/core/record_update_date
A	A WCMP record should provide a <code>properties.updated</code> property when a record has been updated since its initial creation.

1.17 Properties / Status

The `status` property identifies the lifecycle of a given dataset.

```
"properties": {
  "status": {
    "id": "operational",
    "title": "dataset is in 24/7 operation",
    "url": "https://example.org/my-vocab"
  }
}
```

Recommendation 10	/rec/core/status
A	A WCMP record should provide a <code>properties.status</code> property to identify the operational status of a given dataset.
B	A WCMP record should provide a <code>properties.status.id</code> property to identify the concept of the status (see Annex D for possible codelists to use).
C	A WCMP record should provide a <code>properties.status.title</code> property to provide a human readable title for the concept.
D	A WCMP record should provide a <code>properties.status.description</code> property to provide a human readable description for the concept.
E	A WCMP record should provide a <code>properties.status.url</code> property to provide further description of the concept via the given URI.

1.18 Properties / WMO data policy

The `wmo:dataPolicy` property is a codelist that identifies the classification of the dataset exchange as described by [WMO Unified Data Policy](#) for the international exchange of Earth system data. The codelist values are `core` or `recommended`. The `wmo:dataPolicy` property is required if the metadata record describes a dataset.

Licensing and copyright are expressed via the `links` property (see [Distribution information](#)), providing access, license and attribution details as required. Conditions on use of the data should be indicated for transparency and clarification.

Example. Core data

```
"properties": {
  ...
  "wmo:dataPolicy": "core"
  ...
}
```

Example. Recommended data

```
"properties": {
  ...
  "wmo:dataPolicy": "recommended"
  ...
}
```

It is useful to add provider-specific details to have the most detailed information about data policy and additional conditions.

Example. Recommended data with additional conditions and provider-specific details

```
"properties": {
  ...
  "wmo:dataPolicy": "recommended"
  ...
},
"links": [{
  "rel": "license",
  "href": "https://example.org/license",
  "type": "text/html",
  "title": "EUMETSAT DATA LICENSING"
}]
```

Example. License for recommended data in the public domain

```
"properties": {
  ...
  "wmo:dataPolicy": "recommended"
  ...
},
"links": [{
  "rel": "license",
  "href": "https://creativecommons.org/publicdomain/zero/1.0/",
  "type": "text/html",
```

```
"title": "CC0 1.0 Deed | CC0 1.0 Universal | Creative Commons"
}]
```

To express rights not addressed by a license, the `rights` property can be used as follows:

Example. Rights

```
"properties":
  ...
  "rights": "Users are granted free and unrestricted access to this data,
without charge and with no conditions on use. Users are requested to attribute
the producer of this data. WMO Unified Data Policy (Resolution 1 (Cg-Ext
2021))."
  ...
}
```

Requirement 13	/req/core/data_policy
A	When the <code>properties.type</code> property is <code>dataset</code> , the record shall provide exactly one <code>properties.wmo:dataPolicy</code> property.
B	The <code>properties.wmo:dataPolicy</code> property shall be <code>core</code> or <code>recommended</code> .
C	When the <code>properties.wmo:dataPolicy</code> property is <code>recommended</code> , data licensing shall be provided by at least one <code>links</code> item with link relations (<code>rel</code>) of <code>license</code> .

Recommendation 11	/rec/core/data_policy_conditions
A	Additional conditions represented by a <code>links</code> item should also provide a <code>title</code> property to include human-readable information about the link.
B	To express any conditions on use of a given dataset, the <code>properties.rights</code> property should be used.
C	For core data or recommended data compatible with free and unrestricted principles, <code>properties.rights</code> should be declared with exactly the following statement: Users are granted free and unrestricted access to this data, without charge and with no conditions on use. Users are requested to attribute the producer of this data. WMO Unified Data Policy (Resolution 1 (Cg-Ext 2021))
D	For core or recommended data not in the public domain, a copyright statement should be expressed as either a <code>properties.rights</code> statement or a link object with <code>rel=copyright</code> .

Permission 8	/per/core/data_policy
A	For core data (when <code>properties.wmo:dataPolicy</code> property is <code>core</code>), attribution licensing may be provided as needed.
B	For core data (when <code>properties.wmo:dataPolicy</code> is <code>core</code>) or recommended data (when <code>properties.wmo:dataPolicy</code> is <code>recommended</code> , and the data is compatible with free and unrestricted

	principles), a license or public domain statement that is compatible with free and unrestricted principles (such as, Creative Commons CC0) may be expressed as a link object with the <code>license</code> link relation.
C	For core data (when <code>properties.wmo:dataPolicy</code> is <code>core</code>) or recommended data (when <code>properties.wmo:dataPolicy</code> is <code>recommended</code>), a copyright statement may be expressed in <code>properties.rights</code>
D	For core data (when <code>properties.wmo:dataPolicy</code> is <code>core</code>) or recommended data (when <code>properties.wmo:dataPolicy</code> is <code>recommended</code>), a link object may be expressed with <code>rel=copyright</code> .

1.19 Links and distribution information

1.19.1 Overview

The `links` property describes URLs and APIs for accessing the dataset or for subscribing to dataset notifications. Links are the primary mechanism for interacting with the data and provide an "actionable" workflow to enhance and improve the user experience with "less clicks" for subscriptions and downloads.

The `links` property may also describe URLs for related documentation, related data, or visual images of the dataset.

The table below provides an overview of the properties of a link object.

Table. Link properties

Property	Requirement	Description
<code>href</code>	Required	The link destination or target, or URL.
<code>rel</code>	Optional	The relationship that the link bears in the context of the WCMP record. This is a controlled vocabulary defined in the IANA link relations table or WIS link type codes (see Table. Link relation selection).
<code>type</code>	Optional	The media (or MIME) type of the format of the link.
<code>hreflang</code>	Optional	The language of the content in the link.
<code>title</code>	Optional	A human-readable name for the link (can be used for display on search / discovery web portals).
Channel	Conditional	For data made available via MQTT, the topic to which a user may subscribe to for notifications and access.
Security	Optional	For access-controlled data, a description of the access control mechanism applied (see Access control).
Distribution	Optional	Value added information about the link to further assist the user (additional document, typical file size, etc.) (see Distribution information).

For recommended data, the `links` property may also provide links to services that implement access control in support of authentication and authorization. In secure data use cases, a user needs to be able to detect access-controlled data as part of data discovery and evaluation.

Example. Access controlled link

```
"links": {
  "rel": "link",
  "type": "application/json",
  "title": "link to WAF endpoint",
  "data": {
    "application/json": {
      "endpoint": "https://waf.example.com"
    }
  }
}
```

```

    "href": "https://example.org/data/secure-data",
    "security": {
      "default": {
        "type": "http",
        "scheme": "basic",
        "description": "Please contact the data provider for accessing this secured
resource."
      }
    }
  }
}]

```

Example. Two link objects providing both search and MQTT subscription information

```

"links": [
  {
    "rel": "search",
    "type": "text/html",
    "title": "WOUDC - Data - Station List",
    "href": "https://example.org/data/stations"
  },
  {
    "rel": "items",
    "type": "application/geo+json",
    "title": "WIS2 notification service",
    "href": "mqtt://example.org",
    "channel": "cache/a/wis2/ca-eccc-msc/data/core/weather/surface-based-
observations"
  }
]

```

Example. A links object providing an API capability

```

"links": [
  {
    "rel": "service",
    "type": "application/json",
    "title": "OGC API - Features service",
    "href": "https://example.org/api"
  }
]

```

Example. A links object providing a browse graphic

```

"links": [
  {
    "rel": "preview",
    "type": "image/png",
    "title": "Browse graphic",
    "href": "https://example.org/path/to/browse.png"
  }
]

```

1.19.2 Templated links

Templated links allow for specifying a pattern of a link in support API interaction (where parameter values are variable).

Example. A templated link object of a WMS service providing API access to images

```
"linkTemplates":
  [
    {
      "rel": "item",
      "type": "image/png",
      "title": "Eumetview",
      "uriTemplate": "https://example.org/geoserver/ows?service=WMS&request=GetMap&version=1.3.0&layers=msg_fes:ir108&styles=&format={format}&crs={crs}&bbox={bbox}&width={width}&height={height}",
      "variables": {
        "crs": {
          "description": "...",
          "type": "string",
          "enum": [
            "EPSG:4326",
            "EPSG:3857"
          ]
        },
        "bbox": {
          "description": "...",
          "type": "array",
          "items": {
            "type": "number",
            "format": "double"
          },
          "minItems": 4,
          "maxItems": 4
        },
        "width": {
          "description": "...",
          "type": "number",
          "format": "integer",
          "minimum": 600,
          "maximum": 5000
        },
        "height": {
          "description": "...",
          "type": "number",
          "format": "integer",
          "minimum": 600,
          "maximum": 5000
        },
        "format": {
          "description": "...",
          "type": "string",
          "enum": [
            "image/geotiff",
            "image/geotiff8",
            "image/gif",
            "image/jpeg",
            "image/png; mode=8bit"
          ]
        },
        "sampleRequest": "https://example.org/geoserver/ows?service=WMS&request=GetMap&version=1.3.0&layers=msg_fes:ir108&styles=&format=image/jpeg&crs=EPSG:4326&bbox=-77,-"
```

```
77,77,77&width=800&height=800"
}
}]
```

Requirement 14	/req/core/links
A	A WCMP record shall provide a <code>links</code> property.
B	The <code>links</code> property shall contain at least one link to the data access service allowing users to download the data.
C	The <code>links</code> property shall contain a Web Accessible Folder (WAF) OR an API link for non-real-time data (such as climate records or hydrometric data archives).
D	The <code>links</code> property shall contain access control information for data, products, and services that require authentication or authorization.
E	For representing MQTT links, the URI scheme shall be <code>mqtt</code> (default port 1883) or <code>mqttts</code> (default port 8883) for secure TLS encrypted connections.
F	The <code>links</code> property shall provide the <code>channel</code> property of the MQTT topic for real-time data under which the data publication notifications will be accessible from the WIS2 Global Broker, following the WIS2 topic hierarchy.
G	The <code>links</code> property shall include a valid IANA link relation or WIS link type code.

Recommendation 12	/rec/core/links
A	A WCMP record's links should be provided using secure protocols (such as, HTTPS, MQTTS, etc.).
B	The <code>links</code> property should provide a <code>type</code> property with a valid media type from IANA or as designated by WMO.

Permission 9	/per/core/links
A	The <code>links</code> property may contain a Web Accessible Folder (WAF) OR an API link for real-time data.

1.19.3 Distribution information

The `distribution` property provides information about the format of the dataset, associated documentation and representative examples of the dataset.

Additional distribution information is added to allow more comprehensive discovery services.

Example. Links object with the complete distribution information

```
"links":
  "rel": "search",
  "type": "text/html",
  "title": "EUMETSAT Datastore",
  "href": "https://example.org/data/map/E0:EUM:DAT:MSG:MSG15-RSS",
  "distribution": {
    "availableFormats": [
      {
        "name": "native",
        "description": "This is sent in a compressed Submission Information Package (SIP) by default.",
        "numberOfFiles": 288 per day",

```



```

    "typicalFileSize": "60 MB",
    "typicalFilename": "MSG3-SEVI-MSG15-0100-NA-20130208102743.243000000Z-1051616.zip",
    "samples": {
      "href": "https://example.org/data/access/MSG3-SEVI-MSG15-0100-NA-20130208102743.243000000Z-1051616.zip"
    },
    "documentation": [{
      "rel": "alternate",
      "type": "text/html",
      "title": "SIP documentation and tools",
      "href": "https://www.eumetsat.int/formats#SIP"
    }]
  }
}

```

Recommendation 13	/rec/core/distribution
A	A WCMP record should describe additional distribution information with the <code>links.distribution</code> property to qualify a given service link. This information should be used to build the discovery information and allow the user to find and choose the appropriate service for accessing the data.
B	The <code>links.distribution.availableFormats</code> property should describe the different formats that can be retrieved using the service link.
C	The <code>links.distribution.availableFormats.name</code> property should describe the available format short name.
D	The <code>links.distribution.availableFormats.description</code> should describe the associated format.
E	The <code>links.distribution.availableFormats.typicalFilename</code> should describe the filenames that are available from the service link.
F	The <code>links.distribution.availableFormats.typicalFileSize</code> should describe the typical filesize available from the service link.
G	The <code>links.distribution.availableFormats.numberOfFiles</code> should describe the typical number of files received during a given period (day, month, ...) when using the service link. It should follow the pattern X per day, X per month.
H	The <code>links.distribution.availableFormats.documentation</code> should be a link for accessing the documentation associated with the format.
I	The <code>links.distribution.availableFormats.samples</code> should be an array of direct links to representative samples of the data.

1.19.4 Access control

WCMP record links may also provide links to services that implement access control in support of authentication and authorization. In secure data use cases, a user needs to be able to detect access-controlled data as part of data discovery and evaluation. The example demonstrates how to express access control using HTTP Basic Authentication for a given data access service.

Example

```

"links":
  "rel":
  "type":
  "title": "link to WAF endpoint",
  "href": "https://example.org/data/secure-data",
  "security":
  "default":
  "type": "http",
  "scheme": "basic",
  "description": "Please contact the data provider for accessing this secured
resource."
}
}
}]

```

1.19.5 Link relation selection

Link relations are very important and provide valuable context to help clarify the semantics of a given link or URL.

The table below provides guidance on which link relation to use to identify common types of links to data and services.

Table. Link relation selection

Link type	Link relation (rel=)
Online data archive	archives
Online documentation	about
OpenAPI endpoint (such as, JSON or YAML)	service-desc
OpenAPI endpoint in HTML (such as, Swagger, ReDoc)	service-doc
OGC WMS, WFS, WCS, CSW, WPS Capabilities	service-desc
A single link providing numerous data granules	items
A link providing a single data granule	item
A link to numerous stations that the dataset is based on	stations
A link to a single station that the dataset is based on	station
citation	cite-as
A search portal or web application	search
A zipfile of data, or bulk download	enclosure
A browse graphic of a dataset	preview
An OGC API endpoint providing a collection description	collection

1.20 Additional properties

A WCMP record can be extended as required for organizational purposes by adding properties (of any type) in the record. Additional properties do not break compliance to WCMP.

Example.

```

"properties":
  ...
  "approvalStatus": "approved"
  "_comment":
  "validationErrors":
    "error"
    "error"
  ]
}

```

...
}

Permission 10	/per/core/additional_properties
A	A WCMP record may provide additional properties of any type in any part of the document as needed.

2. _____ WMO Core Metadata Profile resources

2.1. _____ WMO Codes Registry

- <https://codes.wmo.int/wis/topic-hierarchy/centre-id>
- <https://codes.wmo.int/wis/topic-hierarchy/earth-system-discipline>
- <https://codes.wmo.int/wis/topic-hierarchy/data-policy>
- <https://codes.wmo.int/wis/link-type>
- <https://codes.wmo.int/wis/contact-role>

2.2. _____ WMO schemas server

Validation, examples and other resources are published at <https://schemas.wmo.int/wcmp>

Рекомендация 7 (ИНФОМ-3)

Переход от ИСВ 1.0 и Глобальной системы телесвязи (ГСТ) к ИСВ 2.0, включая развитие потенциала

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 23 \(ИС-76\)](#) «Обновление Руководства по информационной системе ВМО»;
- 2) [резолюцию 34 \(ИС-76\)](#) «Обновление Плана осуществления Информационной системы ВМО 2.0»,

с удовлетворением отмечая, что осуществление ИСВ 2.0 идет в соответствии с планом, изложенным в [резолюции 34 \(ИС-76\)](#), а участие Членов в пилотном этапе ИСВ 2.0 превзошло ожидания, о чем сообщается в INFCOM-3/INF 8.3(2b),

отмечая далее важную роль деятельности по развитию потенциала, о чем сообщается в документе INFCOM-3/INF 8.3(2a), включая разработку эталонной реализации узла ИСВ 2.0 в качестве программного обеспечения с открытым исходным кодом в рамках проекта «ИСВ 2.0 в коробке»,

рассмотрев заявление Постоянного комитета по управлению информацией и информационным технологиям (ПК-УИИТ) о роли программного обеспечения с открытым исходным кодом в разработке и реализации технических спецификаций ВМО в документе INFCOM-3/INF. 8.3(2a),

рекомендует Исполнительному совету принять положения о переходе от ИСВ 1.0 и ГСТ к ИСВ 2.0 посредством проекта резолюции, представленного в дополнении к настоящей рекомендации.

Дополнение к рекомендации 7 (ИНФОМ-3)**Проект резолюции №№/1 (ИС-78)**

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на:

- 1) [резолюцию 23 \(ИС-76\)](#) «Обновление Руководства по информационной системе ВМО»;
- 2) [резолюцию 34 \(ИС-76\)](#) «Обновление Плана осуществления Информационной системы ВМО 2.0»,

вновь подтверждая:

- 1) настоятельную необходимость осуществления Информационной системы ВМО 2.0 в поддержку Единой политики ВМО в области данных ([резолюция 1 Кг-Внеоч.\(2021\)](#)) и создания Глобальной опорной сети наблюдений (ГОСН) ([резолюция 2 Кг-Внеоч.\(2021\)](#));
- 2) важность предоставления Членам четких и полных инструкций по переходу от ИСВ 1.0 и ГСТ к ИСВ 2.0;
- 3) важность предоставления четких и полных инструкций Членам, выполняющим функции регионального узла телесвязи (РУТ) от Глобальной системы телесвязи (ГСТ), учитывая переход от ИСВ 1.0 и ГСТ к ИСВ 2.0 и прекращение функций и ответственности;
- 4) намерение ускорить внедрение ИСВ 2.0 путем предоставления готового программного решения для наименее развитых стран (НРС), малых островных развивающихся государств (МОСТРАГ), развивающихся стран и Членов, желающих принять открытый исходный код,

подчеркивая необходимость развития потенциала Членов для содействия осуществлению ИСВ 2.0 и обеспечения того, чтобы ни один из Членов не остался в этом отношении без внимания,

с удовлетворением отмечая, что осуществление ИСВ 2.0 идет в соответствии с планом, изложенным в [резолюции 34 \(ИС-76\)](#), а участие Членов в пилотном этапе ИСВ 2.0 превзошло ожидания,

отмечая далее

- 1) важную роль деятельности по развитию потенциала в деле ускорения осуществления ИСВ 2.0, включая разработку эталонной реализации узла ИСВ 2.0 в качестве программного обеспечения с открытым исходным кодом в рамках проекта «ИСВ 2.0.0 в коробке», о чем сообщается в документе INFCOM-3/INF 8.3(2a);
- 2) что переход к ИСВ 2.0 ускоряется, упрощается и становится более экономически эффективным за счет использования открытых стандартов в соответствии с принципами ИСВ 2.0 и наличия программного обеспечения с открытым исходным кодом для свободного использования Членами и частными организациями в поддержку осуществления ИСВ 2.0;
- 3) действующее требование Международной организации гражданской авиации (ИКАО), изложенное в Приложении 3 к Конвенции о международной гражданской авиации, предписывающее ВМО поддерживать указатели типа данных в

авиационных метеорологических кодах, включая указатели данных T₁T₂A₁A₂ii в сокращенных заголовках, приведенные в приложении II-5 [Наставления по глобальной системе телесвязи](#) (ВМО-№ 386);

- 4) важную и значимую роль, которую сыграло программное обеспечение «ИСВ 2.0 в коробке», позволившее НРС, МОСТРАГ, а также развивающимся странам и Членам Организации участвовать во внедрении ИСВ 2.0, важность этого программного обеспечения для соблюдения требований ГОСН, а также потребность в нем и последствия для НРС и МОСТРАГ в удовлетворении их потребностей, связанных с Фондом финансирования систематических наблюдений (ФФСН),

признавая возросшую потребность в глобальном обмене метеорологическими и гидрологическими данными и жизненно важную роль программного обеспечения «ИСВ 2.0 в коробке» в поддержке НРС, МОСТРАГ, а также развивающихся стран и Членов в реализации Единой политики ВМО в области данных, решений, связанных с ГОСН, Интегрированной глобальной системой наблюдений ВМО (ИГСНВ) и ИСВ 2.0, а также необходимость укрепления поддержки ВМО и ее сотрудничества с Членами Организации в этом отношении,

признавая далее:

- 1) важность улучшения доступа к данным метеорологических и гидрологических наблюдений, которое обеспечивает программное обеспечение «ИСВ 2.0 в коробке», и необходимость для МОСТРАГ и НРС продолжать ускорять внедрение «ИСВ 2.0 в коробке» в контексте устойчивости ГОСН и соответствующих потребностей ФФСН, и что для этого потребуются расширение знаний и экспертного опыта национальных метеорологических и гидрологических служб (НМГС) МОСТРАГ и НРС в области внедрения ИСВ 2.0;
- 2) необходимость усиления деятельности по наращиванию потенциала НМГС, особенно в НРС и МОСТРАГ, путем предоставления технических экспертных знаний, обучения, семинаров-практикумов и других форм помощи, чтобы обеспечить обмен данными в соответствии с ГОСН и Единой политикой ВМО в области данных,

рассмотрев [рекомендацию 7 \(ИНФКОМ-3\)](#),

согласовав [рекомендацию 7 \(ИНФКОМ-3\)](#),

постановляет:

- 1) одобрить публикацию «Положений о переходе от ИСВ 1.0 и ГСТ к ИСВ 2.0», изложенных в дополнении;
- 2) что [Наставление по Глобальной системе телесвязи](#) (ВМО-№ 386) больше не будет обновляться с 31 декабря 2024 года;

призывает Членов внести свой вклад в дальнейшее развитие проекта «ИСВ 2.0 в коробке» путем внесения технического вклада в программное обеспечение с открытым исходным кодом и финансового вклада в целевой фонд ИСВ;

порукает ИНФКОМ рассмотреть вопрос о разработке всеобъемлющего руководства по прекращению функционирования РУТ;

порукает Генеральному секретарю:

- 1) опубликовать «Положения о переходе от ИСВ 1.0 и ГСТ к ИСВ 2.0», изложенные в дополнении к настоящей резолюции, в качестве новой нумерованной публикации ВМО на всех официальных языках ВМО;

- 2) взаимодействовать с ИКАО по вопросу действующего требования в отношении приложения II-5. Указатели данных T₁T₂A₁A₂ii в сокращенных заголовках *Наставления по глобальной системе телесвязи* (ВМО-№ 386) в будущем будут поддерживаться ВМО в соответствующей альтернативной официальной публикации;
- 3) укреплять приверженность ВМО внедрению ИСВ 2.0 и продолжать оказывать помощь Членам в ее внедрении путем поддержки и обеспечения непрерывности и дальнейшего развития программного обеспечения «ИСВ 2.0 в коробке», а также оказывать содействие в предоставлении технических экспертных знаний и мобилизации финансовых ресурсов, необходимых для его эффективной разработки, чтобы гарантировать, что ни один Член не останется в стороне во время перехода к ИСВ 2.0 и ее внедрения;
- 4) взаимодействовать с Ассоциацией производителей гидрометеорологического оборудования (ПГМО) для обеспечения готовности частного сектора к оказанию поддержки Членам в переходе к ИСВ 2.0, включая реализацию программного обеспечения для проекта «ИСВ 2.0 в коробке» и оказание технической поддержки;
- 5) оказывать поддержку программе развития потенциала ИСВ 2.0 на региональном уровне с учетом необходимости обучения на разных языках.

Для получения дополнительной информации см. INFCOM-3/INF. 8.3(2a) и INFCOM-3/INF. 8.3(2b).

Дополнение к проекту резолюции №№/1 (ИС-78)

Положения о переходе от ИСВ 1.0 и ГСТ к ИСВ 2.0

1. ПРЕАМБУЛА

В данной публикации представлены положения о переходе от ИСВ 1.0 и ГСТ к ИСВ 2.0. В положениях о переходе к ИСВ 2.0 содержатся технические руководящие указания и описаны практики, которым должны следовать Члены для осуществления ИСВ 2.0 и вывода из эксплуатации систем ИСВ 1.0 и ГСТ. Практики, описанные в данной публикации, способствуют беспрепятственному осуществлению технических правил, изложенных в публикации *Manual on the WMO Information System, Volume II – WMO Information System 2.0* (Наставлении по Информационной системе ВМО, том II — Информационная система ВМО 2.0) (WMO-№. 1060), а также в *Руководстве по информационной системе ВМО* (ВМО-№ 1061).

2. ВВЕДЕНИЕ

Исполнительный совет в *резолюции 34 (ИС-76)* «Обновление Плана осуществления Информационной системы ВМО 2.0» одобрил План осуществления Информационной системы ВМО 2.0 (ИСВ 2.0) и признал важность проведения пилотного этапа для разработки инфраструктуры ИСВ 2.0 и начала ее тестирования, чтобы подготовиться к предоперативному этапу в 2024 году, а затем к переходу, начиная с 2025 года. Данный план будет выполняться в соответствии с графиком, представленным на рисунке 1. Пилотный этап завершился в конце 2023 года, при этом в создании инфраструктуры ИСВ 2.0 совместно участвовали несколько стран. Каждая страна играла свою роль в создании механизма ИСВ 2.0 и реализовывала конкретный компонент. Начиная с января 2024 года осуществление ИСВ 2.0 перейдет к предоперативному этапу, и службы ИСВ 2.0 будут готовы к переходу к рабочей конфигурации, что крайне важно для обеспечения того, чтобы ИСВ 2.0 могла оперативно обслуживать сообщество ВМО с

начала 2025 года. Переход к ИСВ 2.0 планируется осуществить в период с 2025 по 2030 год, при этом ожидаемый уровень достижения прогресса составит до 90 %. ГСТ планируется вывести из эксплуатации к 2033 году.

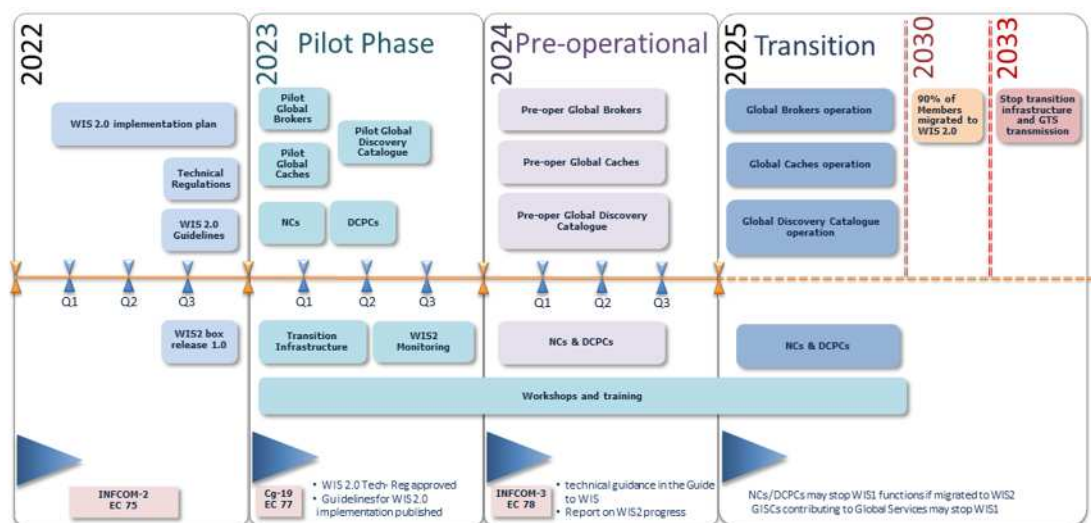


Рисунок 1. Сроки осуществления ИСВ 2.0

3. ПРИНЦИПЫ

При обеспечении перехода следует руководствоваться следующими принципами:

Принцип 1. Каждая национальная метеорологическая и гидрологическая служба (НМГС) сможет осуществить переход в течение согласованного периода 2025—2030 годов:

- НМГС будут осуществлять переход в период с 2025 по 2030 год в удобное для них время. Переход всех центров ИСВ от ИСВ 1.0 к ИСВ 2.0 не будет одновременным.

Принцип 2. Отсутствие потери данных ГСТ во время перехода:

- На предоперативном этапе в координации с региональными ассоциациями и Глобальным центром информационной системы (ГЦИС) будет создана инфраструктура ИСВ 2.0, чтобы избежать потери данных во время перехода. Цель данной инфраструктуры заключается в обеспечении того, чтобы данные, отправленные по ГСТ, могли быть получены центром, осуществившим переход к ИСВ 2.0, и данные, ранее отправленные по ГСТ, отправленные по ИСВ 2.0, могли быть получены центром, который все еще использует ГСТ.

Принцип 3. Каждый центр сам решает, когда выводить из эксплуатации ИСВ 1.0 и ГСТ:

- Решение о выводе из эксплуатации служб ИСВ 1.0 и ГСТ будет приниматься самостоятельно каждым национальным центром (НЦ) / центром сбора данных или продукции (ЦСДП) / ГЦИС, когда они сочтут, что переход завершен для них и их пользователей;
- после перехода к ИСВ 2.0 не требуется запускать систему коммутации сообщений (СКС) для получения или отправки данных из центров, не осуществивших переход. Центры сами решают, когда прекратить работу их СКС, и хотят ли они это сделать. Они также могут прекратить передачу данных в ГСТ.

Принцип 4. Обмен новыми данными (например, ГОСН, климат, гидрология, криосфера) будет осуществляться исключительно в рамках ИСВ 2.0:

- ИСВ 2.0 предназначена для реализации Единой политики ВМО в области данных и для поддержки Глобальной опорной сети наблюдений ВМО. Новые данные будут

передаваться в рамках ИСВ 2.0. Центр, не осуществивший переход к ИСВ 2.0, не будет получать новые данные. Эти данные не будут иметь заголовки ТТААii ГСТ и не будут передаваться по ГСТ.

4. ВРЕМЕННЫЕ ГЛОБАЛЬНЫЕ СЛУЖБЫ

4.1 Межсетевой интерфейс ГСТ — ИСВ 2.0

Исполнительный совет в [резолюции 34 \(ИС-76\)](#) одобрил План осуществления Информационной системы ВМО 2 (ИСВ 2.0) и признал важность проведения пилотного этапа для разработки инфраструктуры ИСВ 2.0 и начала ее тестирования, чтобы подготовиться к предоперативному этапу в 2024 году, а затем к переходу начиная с 2025 года. Согласно Плану осуществления ИСВ 2.0, ГСТ будет выведена из эксплуатации к 2030 году, а НМГС будут использовать платформу ИСВ 2.0 для обмена данными.

В переходный период, чтобы некоторые центры ИСВ не были вынуждены одновременно использовать обе системы обмена данными (ИСВ 2.0 и ГСТ), решая проблемы, связанные с поддержанием двух оперативных систем для одной и той же цели, спроектирован межсетевой интерфейс ГСТ — ИСВ 2.0, учитывающий время, необходимое Членам для осуществления перехода к новым системам, и сводящий к минимуму время, в течение которого Член должен эксплуатировать параллельно обе системы.

4.1.1 Цель

Межсетевой интерфейс ГСТ — ИСВ 2.0 предназначен для того, чтобы Члены, осуществившие переход к ИСВ 2.0 и прекратившие работу своих систем ГСТ, могли продолжать получать данные ГСТ из ИСВ 2.0. Данный межсетевой интерфейс также позволяет пользователям, не подключенным к ГСТ, получать доступ к данным ГСТ из ИСВ 2.0 на переходном этапе. Межсетевой интерфейс ГСТ — ИСВ 2.0 будет перенаправлять трафик ГСТ, который он получает, в ИСВ 2.0. В соответствии со спецификацией ИСВ 2.0 все данные, полученные по одному каналу ГСТ, будут храниться в конечной точке HTTP(s) межсетевого интерфейса и генерировать уведомительное сообщение ИСВ 2.0 (WIS2 Notification Message).

4.1.2 Провайдер межсетевого интерфейса ГСТ — ИСВ 2.0

Для обеспечения устойчивой работы будет использоваться несколько межсетевых интерфейсов ГСТ — ИСВ 2.0.

4.1.3 Технические требования

- Межсетевой интерфейс ГСТ — ИСВ 2.0 — это функция ЦСДП. Применяются все требования, относящиеся к узлам ИСВ 2.0. Межсетевой интерфейс ГСТ — ИСВ 2.0 получит от Секретариата ВМО уникальный идентификатор центра (centre-id).
- В дополнение к стандартным спецификациям узла ИСВ 2.0 межсетевой интерфейс ГСТ — ИСВ 2.0 будет поддерживать следующее:
 - Иерархия тем для данных ГСТ в ИСВ 2.0 будет следующей:

`origin/a/wis2/{centre-id}/data/[core|recommended]/T1/T2/A1/A2/ii/CCCC`

например, для DWD (Метеорологическая служба Германии):

`origin/a/wis2/de-dwd-gts-to-wis2/data/[core|recommended]/T1/T2/A1/A2/ii/CCCC`

и для JMA (Японское метеорологическое агентство):

`origin/a/wis2/jp-jma-gts-to-wis2/data/[core|recommended]/T1/T2/A1/A2/ii/CCCC`

- Указанные выше **T1/T2/A1/A2/ii/CCCC** образуются из заголовков данных, полученных по ГСТ.
- Глобальные кэши будут кэшировать данные, которые публикуются с использованием основных данных в иерархии тем.
- Потребители данных, получающие данные ГСТ через ИСВ 2.0, должны уметь работать с дубликатами. Это соответствует текущей практике работы с дубликатами сообщений в ГСТ.
- Доступ к рекомендованным данным ГСТ должен быть ограничен Членами ВМО.
- Каждый межсетевой интерфейс ГСТ — ИСВ 2.0 поддерживает список заголовков ТТААii для рекомендуемых данных, чтобы иметь возможность отправлять уведомление в нужную тему. Этот список согласовывается и распространяется между операторами межсетевых интерфейсов.

4.2 Межсетевой интерфейс ИСВ 2.0 — ГСТ

План осуществления ИСВ 2.0 предусматривает постепенный переход обмена данными от Глобальной системы телесвязи (ГСТ) к ИСВ 2.0. Ожидается, что переход будет осуществлен в период с 2025 по 2030 год. После завершения перехода ГСТ будет выведена из эксплуатации.

4.2.1 Цель

Когда национальный метеорологический центр (НМЦ), использующий СКС и обменивающийся данными по ГСТ, осуществит ИСВ 2.0, он может захотеть прекратить отправку своих данных непосредственно по ГСТ, чтобы прекратить работу СКС.

Межсетевой интерфейс ИСВ 2.0 — ГСТ обеспечит повторную публикацию в ГСТ **только тех данных, которые в настоящее время доступны в ГСТ** и чей центр ИСВ желает прекратить работу СКС, чтобы не потерять данные во время перехода.

Для обеспечения устойчивой работы будет использоваться несколько межсетевых интерфейсов ИСВ 2.0 — ГСТ.

4.2.2 Операторы межсетевого интерфейса ИСВ 2.0 — ГСТ

Межсетевой интерфейс будет предоставляться назначенными региональными узлами телесвязи (РУТ).

4.2.3 Технические требования

4.2.3.1 Для центров ИСВ, желающих прекратить работу своих СКС

Член, планирующий прекратить передачу данных по ГСТ, должен * предоставлять свои данные в соответствии с операциями узла ИСВ 2.0 в ИСВ 2.0 * для данных, которые ранее были доступны в ГСТ и которые должны оставаться доступными в ГСТ, центр ИСВ (или Член) **должен указывать строку сокращенного заголовка (ССЗ) ГСТ бюллетеня, в котором эти данные должны быть опубликованы**. Это делается путем включения свойства ГСТ в уведомительное сообщение ИСВ 2.0 (см. пример ниже).

Свойство ГСТ позволяет оператору межсетевого интерфейса ИСВ 2.0 — ГСТ легко идентифицировать данные для повторной публикации в ГСТ и ССЗ связанных с этим данных.

```
"properties": {  
  ...  
  "gts": {  
    "ttaaii": "FTAE31",  
    "cccc": "VTBB"  
  }  
}
```

Что касается основных данных, глобальный кэш обеспечит их нормальную работу, и данные, которые будут переданы в ГСТ, будут доступны в глобальном кэше. Что касается рекомендованных данных, центр ИСВ должен предоставить неограниченный доступ с межсетевых интерфейсов. Они проинформируют об этом Секретариат ВМО, чтобы межсетевой интерфейс установил необходимые подписки.

4.2.3.2 Для операторов межсетевого интерфейса ИСВ 2.0 — ГСТ

В течение переходного периода оператор межсетевого интерфейса ИСВ 2.0 — ГСТ должен управлять следующими компонентами:

- a) Потребитель данных для извлечения данных, опубликованных в ИСВ 2.0. Все спецификации потребителя данных относятся к межсетевому интерфейсу ИСВ 2.0 — ГСТ,
- b) СКС с необходимой конфигурацией для доступа ко всем РУТ,
- c) Кроме того, межсетевой интерфейс должен реализовать механизм, позволяющий потребителю данных предоставлять данные для отправки в ГСТ с требуемыми ТТААii и СССС в адрес локальной СКС. СКС межсетевого интерфейса будет обрабатывать входящие файлы данных, собирая отдельные элементы в бюллетени в соответствии со стандартной конфигурацией, и публиковать эти бюллетени в ГСТ для последующего распространения через РУТ по Главной сети телесвязи (ГСЕТ) и за ее пределами.

Данный механизм зависит от выбора локальной реализации и может варьироваться от одного межсетевого интерфейса к другому.

В течение переходного периода список ТТААii/СССС для ретрансляции из ИСВ 2.0 в ГСТ будет расширяться, когда новые НМЦ запланируют прекратить работу своих СКС. Это означает, что межсетевому интерфейсу потребуется метод, позволяющий добавлять пакеты ТТААii/СССС, когда новые центры будут готовы к переходу.

Как ожидается, для потребителей данных и для обеспечения устойчивой работы, межсетевой интерфейс должен подписаться на уведомительные сообщения от нескольких глобальных брокеров.

В течение переходного периода другие межсетевые интерфейсы будут повторно публиковать данные ГСТ в ИСВ 2.0. Эти межсетевые интерфейсы ГСТ — ИСВ 2.0 будут публиковать информацию, используя назначенный идентификатор центра. Чтобы избежать бесконечного цикла повторных публикаций, необходимо, чтобы межсетевой интерфейс ИСВ 2.0 — ГСТ **не** подписывался на уведомительные сообщения, связанные с идентификатором центра межсетевого интерфейса ГСТ — ИСВ 2.0.

5. ПРЕКРАЩЕНИЕ РАБОТЫ СИСТЕМЫ КОММУТАЦИИ СООБЩЕНИЙ (СКС)

Благодаря функциям межсетевого интерфейса, описанным в предыдущей главе, центры ИСВ, использующие в настоящее время ГСТ для обмена оперативными данными, после успешного внедрения узла ИСВ 2.0 с дополнительными функциями, которые необходимы межсетевым интерфейсам для того, чтобы предоставлять услуги межсетевых интерфейсов, смогут прекратить работу своих СКС, если они того пожелают, до полного завершения перехода. Постепенное прекращение работы всех СКС должно осуществляться упорядоченным и скоординированным образом, чтобы все данные, необходимые Членам для их деятельности, оставались доступными.

В разделе «Управление ИСВ 1.0 и ГСТ» данного Руководства по осуществлению перехода упоминается о различных функциях в ГСТ (НМЦ, РУТ, мировые метеорологические центры (ММЦ)). В нем также подробно описано, когда центр может прекратить работу СКС. Когда все условия для центра выполнены, можно применить следующую процедуру вывода из эксплуатации.

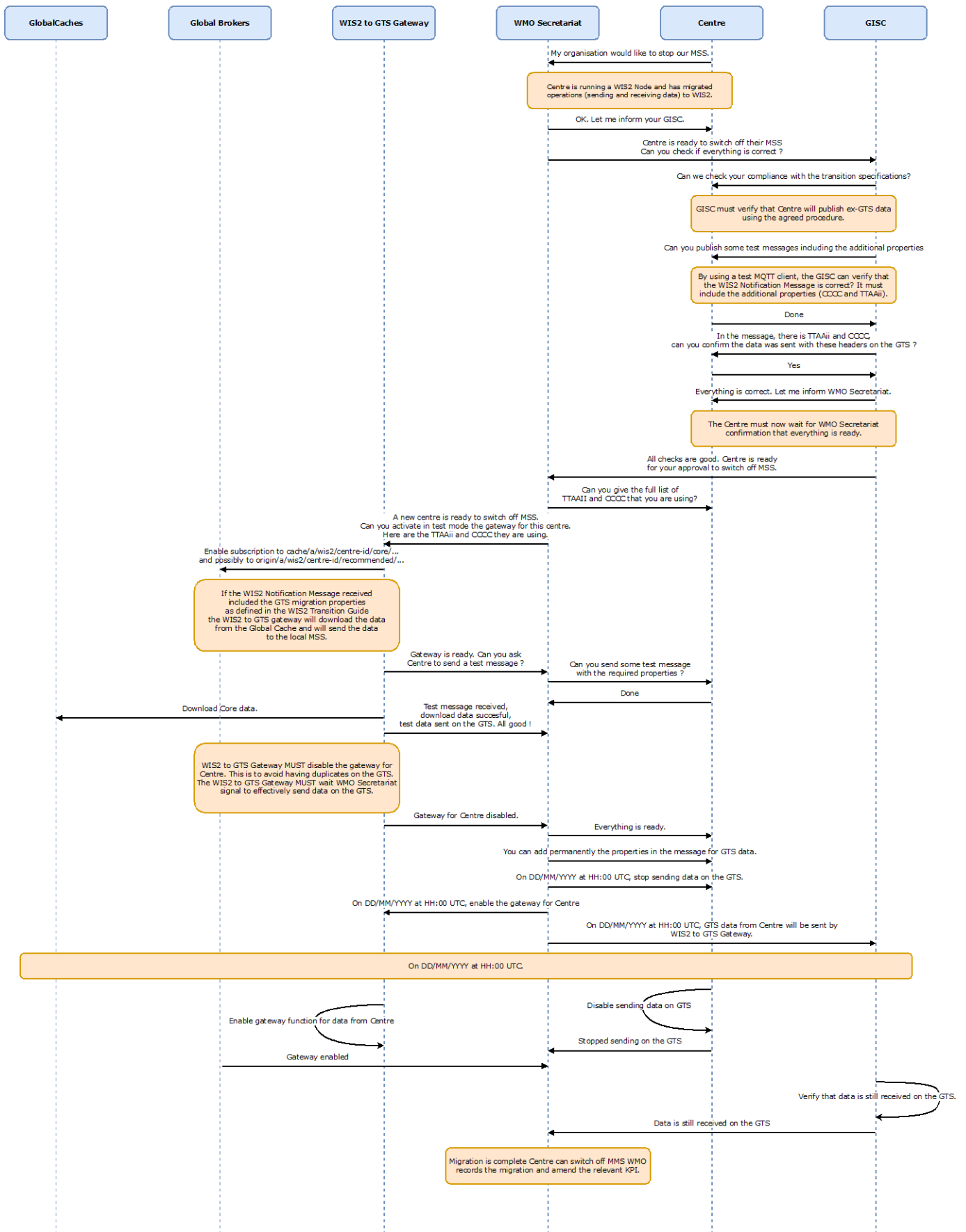


Рисунок 2. Процедура вывода СКС из эксплуатации

Диаграмма последовательности действий содержит перечень необходимых действий и описание роли различных структур, участвующих в этих действиях. **Ключевую роль будет играть ответственный за центр Глобальный центр информационной системы (ГЦИС).** ГЦИС должен будет убедиться, что центр должным образом выполнил требования и что процедура хорошо понятна центру, чтобы не потерять данные во время перехода. Секретариат ВМО будет выступать в качестве координационного органа между всеми сторонами. Очень важно, чтобы все стороны строго следовали согласованной процедуре.

Следует также отметить, что окончательное переключение (прекращение работы СКС центром и активация функции межсетевого интерфейса для ТТААii/CCCC центра ИСВ) произойдет в один и тот же момент. Точное время и дата будут выбраны различными сторонами под контролем Секретариата ВМО.

По запросу центра Секретариат ВМО будет информировать межсетевые интерфейсы о том, что новый идентификатор центра желает использовать функцию ретрансляции, а также о необходимых темах подписки. По запросу Секретариата ВМО межсетевой интерфейс будет реализовывать следующие подписки:

- a) Subscribe to notifications on the topic: +cache/a/wis2/{centre-id}/data/#+, где {centre-id} относится к узлу ИСВ 2.0, желающему остановить родную функцию ГСТ,
- b) Potentially subscribe to +origin/a/wis2/{centre-id}/data/recommended/#+ для узла ИСВ 2.0, имеющего также рекомендованные данные в ГСТ.

Важно: подписка на эти темы не должна подразумевать немедленную отправку данных в ГСТ. Для размещения данных в ГСТ потребуется явно выраженное согласие Секретариата ВМО. Операторы межсетевых интерфейсов должны сами реализовать этот «выключатель» (например, отключение подписки, блокировка потока между потребителем данных и СКС только для этих ТТААii/CCCC, ...).

6. УПРАВЛЕНИЕ ИСВ 1.0 И ГСТ

Во время перехода к ИСВ 2.0 поддержание очень высокого уровня обслуживания ИСВ 1.0 и ГСТ является ключевым условием для того, чтобы все Члены и пользователи ИСВ, независимо от того, осуществили ли они переход к ИСВ 2.0 или по-прежнему используют ГСТ, могли отправлять и получать данные, необходимые для осуществления своей деятельности. Как уже говорилось, ключевую роль в этом будут играть межсетевой интерфейс ИСВ 2.0 — ГСТ и межсетевой интерфейс ГСТ — ИСВ 2.0. Ниже приводится описание того, что Члены должны делать во время этого перехода в зависимости от их роли в ГСТ и ИСВ 1.0.

6.1 Обслуживание и эксплуатация системы коммутации сообщений (СКС)

6.1.1 Главная сеть телесвязи

Во время перехода к ИСВ 2.0 ГСЕТ, связывающая ММЦ, а также назначенные РУТ должны поддерживать свои СКС в рабочем состоянии и продолжать публиковать данные, собирая бюллетени от связанных с ними НМЦ и передавая их в соответствующей форме по ГСЕТ, либо напрямую, либо через соответствующий ММЦ, пока переход от ГСТ к ИСВ 2.0 не будет завершен.

6.1.2 Региональные узлы телесвязи (РУТ)

РУТ должны поддерживать свои СКС в рабочем состоянии и продолжать публиковать данные, собирая бюллетени от связанных с ними НМЦ и передавая их в соответствующей

форме по ГСЕТ либо напрямую, либо через соответствующий ММЦ /РУТ в ГСТ, пока все Члены в их зоне ответственности не осуществят переход от ГСТ к ИСВ 2.0.

Когда РУТ осуществляют переход к узлу ИСВ 2.0 и все Члены в их зоне ответственности осуществляют переход к ИСВ 2.0, РУТ могут принять решение об отключении своих СКС.

В этом случае они должны связаться с Секретариатом ВМО, чтобы согласованно отключить свои СКС.

6.1.3 Национальные метеорологические центры (НМЦ)

НМЦ должны управлять узлом ИСВ 2.0 для обмена своими данными и метаданными обнаружения в ИСВ 2.0.

НМЦ, реализовавшие узел ИСВ 2.0 и опубликовавшие все данные, передаваемые по ГСТ, в ИСВ 2.0, могут, при желании, отключить свои СКС системы ГСТ и прекратить передачу данных по ГСТ. Когда НМЦ принимают решение о выводе из эксплуатации и отключении СКС системы ГСТ и прекращении передачи своих данных по ГСТ, они должны включить свойства ГСТ в уведомительном сообщении, как описано в технических требованиях к межсетевому интерфейсу ИСВ 2.0 — ГСТ.

Примечание: данное обновление уведомительного сообщения будет касаться только тех данных, которые уже опубликованы в ГСТ. Новые данные будут публиковаться только в ИСВ 2.0.

6.2 Обслуживание и эксплуатация каталога и кэша ИСВ 1.0 силами ГЦИС

Каждый ГЦИС должен поддерживать свой каталог и кэш, если пользователи ИСВ пользуются их услугами для оперативной работы. ГЦИС предлагается оказывать помощь пользователям, осуществляющим переход к ИСВ 2.0. После того, как их пользователи успешно осуществили переход к ИСВ 2.0, ГЦИС могут прекратить работу служб кэша и каталога ИСВ 1.0 и должны проинформировать об этом Секретариат ВМО.

ГЦИС Сеул и ГЦИС Оффенбах будут продолжать предоставлять метаданные обнаружения ИСВ 1.0 и каталог ИСВ 1.0 до тех пор, пока переход от ГСТ и ИСВ 1.0 к ИСВ 2.0 не будет завершен или пока они не будут признаны ненужными, когда все пользователи ИСВ 1.0 осуществят переход к ИСВ 2.0.

С 2025 года в каталоге ИСВ 1.0 не будут размещаться ни новые метаданные обнаружения, ни изменения существующих метаданных. Будут добавляться только новые данные в ОПМВ2 в глобальный каталог метаданных обнаружения для ИСВ 2.0. Изменение существующей записи метаданных в ИСВ 1.0 будет подразумевать перенос записи метаданных в ИСВ 2.0 в соответствии со стандартом ОПМВ2 и связанными с ним передовыми практиками и ключевыми показателями эффективности.

6.3 Управление сокращенными заголовками ГСТ

Информация о сокращенных заголовках ГСТ приведена в [Наставлении по Глобальной системе телесвязи](#) (ВМО-№ 386). Указатели данных T₁T₂A₁A₂i₁i₂ определены в приложении II данного Наставления. Сокращенные заголовки ГСТ не требуются в ИСВ 2.0, и их использование ограничено обменом данными по ГСТ. Начиная с момента введения ИСВ 2.0 в эксплуатацию любое дальнейшее развитие ГСТ, включая передачу новых данных, не будет разрешено. Таким образом, Наставление по ГСТ больше не будет обновляться с 31 декабря 2024 года. В томе С1 публикации [Weather Reporting](#) (Метеорологические сообщения) (WMO-No. 9) содержится список метеорологических бюллетеней, которыми обмениваются в ГСТ. К Членам предъявляется требование обновлять том С1 каждый раз, когда происходят изменения в бюллетенях, но лишь некоторые Члены делают это регулярно, и поэтому этот список неполный и не

соответствует бюллетеням, которыми фактически обмениваются в ГСТ. С началом оперативного этапа ИСВ 2.0 в список метеорологических бюллетеней, передаваемых по ГСТ, изменения вносятся не будут, поэтому с 31 декабря 2024 года том С1 больше не будет обновляться.

6.3.1 Заголовки ГСТ для ИКАО (AFTN)

Указатели данных T₁T₂A₁A₂ii в приложении II.5 [Наставления по Глобальной системе телесвязи](#) (ВМО-№ 386), которые в настоящее время используются для передачи данных по ГСТ, также используются ИКАО для той же цели в AFTN. К ВМО предъявляется требование поддерживать указатели данных для целей передачи данных ИКАО. Чтобы удовлетворить это требование, Секретариат ВМО будет сотрудничать с ИКАО, чтобы можно было добавлять новые указатели данных, когда это потребует ИКАО. Новые указатели данных, запрашиваемые ИКАО, не будут публиковаться в [Наставлении по Глобальной системе телесвязи](#) (ВМО-№ 386); ВМО и ИКАО согласуют другой способ их публикации.

7. УПРАВЛЕНИЕ ЦЕНТРАМИ ИСВ

7.1 Национальные центры (НЦ)

НЦ могут начать осуществление перехода к ИСВ 2.0 с января 2025 года, когда ИСВ 2.0 будет введена в эксплуатацию. Рекомендуется начать планирование и подготовку заранее таким образом, чтобы переход был завершен предпочтительно к 2030 году и не позднее 2033 года. Переход национального центра к ИСВ 2.0 можно считать завершенным, если для НЦ функционирует хотя бы один узел ИСВ 2.0 и все наборы данных, передаваемые по ГСТ, также совместно используются в ИСВ 2.0 в соответствии с техническими требованиями, описанными в [Наставлении по ИСВ](#) (ВМО-№ 1060), том II — Информационная система ВМО 2.0, и [Руководстве по ИСВ](#) (ВМО-№ 1061). Национальный центр, полностью осуществивший переход к ИСВ 2.0, сообщает Секретариату о завершении перехода и поддерживает работоспособность систем ИСВ 1.0 и ГСТ параллельно с ИСВ 2.0 до получения сообщения от Секретариата, разрешающего переключиться с систем ИСВ 1.0 и ГСТ.

7.2 Центры сбора данных или продукции (ЦСДП)

ЦСДП могут начать осуществление перехода к ИСВ 2.0 с января 2025 года, когда ИСВ 2.0 будет введена в эксплуатацию. Рекомендуется начать планирование и подготовку заранее таким образом, чтобы переход был завершен предпочтительно к 2030 году и не позднее 2033 года. Переход ЦСДП к ИСВ 2.0 можно считать завершенным, если для ЦСДП функционирует хотя бы один узел ИСВ 2.0 и все наборы данных, передаваемые по ГСТ, также совместно используются в ИСВ 2.0 в соответствии с техническими требованиями, описанными в [Наставлении по ИСВ](#) (ВМО-№ 1060), том II — Информационная система ВМО 2.0, и [Руководстве по ИСВ](#) (ВМО-№ 1061). ЦСДП, полностью осуществивший переход к ИСВ 2.0, сообщает Секретариату о завершении перехода и поддерживает работоспособность систем ИСВ 1.0 и ГСТ параллельно с ИСВ 2.0 до получения сообщения от Секретариата, разрешающего переключиться с систем ИСВ 1.0 и ГСТ.

7.3 Глобальные центры информационной системы

ГЦИС должен оказывать поддержку Членам в своей зоне ответственности в осуществлении перехода и эксплуатации ИСВ 2.0.

8. ССЫЛКИ

8.1 Нормативные материалы

- ВМО: [Наставление по ИСВ](#) (ВМО-№ 1060), том II. ИСВ 2.0
- ВМО: Основной профиль метаданных ВМО, версия 2 (ОПМВ2)¹⁴⁵
- ВМО: WIS2 Topic Hierarchy (WTH) (Иерархия тем ИСВ 2.0 (ИТИ))¹⁴⁶
- ВМО: WIS2 Notification Message (WNM) format (формат уведомительного сообщения ИСВ 2.0 (УСМ))¹⁴⁷
- ВМО: WIS2 Metric Hierarchy (WMH) (Иерархия метрик ИСВ 2.0 (ИМИ))¹⁴⁸

8.2 Информационные материалы

- ВМО: [Стратегия Информационной системы ВМО 2.0](#) (ВМО-№ 1213)¹⁴⁹
- ВМО: [Руководящие принципы ВМО по новым вопросам в области данных](#) (ВМО-№ 1239)¹⁵⁰

Рекомендация 8 (ИНФОМ-3)

Поправки к Наставлению по кодам (ВМО-№ 306)

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на [резолюцию 34 \(ИС-76\)](#) «Обновление Плана осуществления Информационной системы ВМО 2.0»,

принимая во внимание:

- 1) План перехода с Глобальной системы телесвязи (ГСТ) на ИСВ 2.0, который ускоряет внедрение BUFR;
- 2) очень ограниченное использование формата CREX Членами в оперативном обмене данными;
- 3) что разработка новых кодов CREX прекратилась в течение многих лет из-за отсутствия запросов со стороны Членов,

приняв во внимание [Общее резюме работы сессии \(Кг-XIV\)](#), в котором сказано, что использование CREX является промежуточным шагом в процессе перехода к BUFR,

рекомендует Исполнительному совету принять поправки к [Наставлению по кодам](#) (ВМО-№ 306) в проекте резолюции, приведенном в дополнении к настоящей рекомендации.

¹⁴⁵ <https://wmo-im.github.io/wcmp2>

¹⁴⁶ <https://github.com/wmo-im/wis2-topic-hierarchy>

¹⁴⁷ <https://wmo-im.github.io/wis2-notification-message>

¹⁴⁸ <https://github.com/wmo-im/wis2-metric-hierarchy>

¹⁴⁹ https://library.wmo.int/index.php?lvl=notice_display&id=20422

¹⁵⁰ https://library.wmo.int/index.php?lvl=notice_display&id=21644

Дополнение к рекомендации 8 (ИНФОМ-3)

Проект резолюции №№/1 (ИС-№№)

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на [резолюцию 34 \(ИС-76\)](#) «Обновление Плана осуществления Информационной системы ВМО 2.0»,

приняв во внимание [Общее резюме работы сессии \(Кг-XIV\)](#), в котором сказано, что использование CREX является промежуточным шагом в процессе перехода к BUFR,

изучив [рекомендацию 8 \(ИНФОМ-3\)](#),

согласившись с [рекомендацией 8 \(ИНФОМ-3\)](#),

постановляет:

- 1) принять поправки к [Наставлению по кодам](#) (ВМО-№ 306), которые приводятся в дополнении к настоящей резолюции;
- 2) более не обновлять таблицы кодов CREX в [Наставлении по кодам](#) (ВМО-№ 306), том I.2 — Международные коды;

порукает Генеральному секретарю опубликовать Наставление по кодам (ВМО-№ 306) с поправками согласно дополнению.

Дополнение к проекту резолюции №№/1 (ИНФОМ-3)

Поправки к Наставлению по кодам (ВМО-№ 306)

В [Наставление по кодам](#) (ВМО-№ 306), том I.2 — Международные коды, вносится поправка путем добавления следующего текста к описанию FM 95 CREX:

FM 95–XIV CREX **Буквенная форма для представления данных и обмена ими**

Использование формы CREX настоятельно не рекомендуется, и таблицы CREX больше не будут обновляться. Вместо CREX следует использовать BUFR.

Рекомендация 9 (ИНФОМ-3)

Поправки к Наставлению по Комплексной системе обработки и прогнозирования ВМО (ВМО-№ 485) для прогнозирования погоды

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 18 \(ИС-69\)](#) «Пересмотренное Наставление по Глобальной системе обработки данных и прогнозирования (ВМО-№ 485)»;

- 2) [резолюцию 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля»;
- 3) [резолюцию 1 \(СЕРКОМ-2\)](#) «Обновления *Наставления по Глобальной системе обработки данных и прогнозирования (ВМО-№ 485)*, предложенные постоянными комитетами СЕРКОМ»;
- 4) [рекомендацию 23 \(ИНФКОМ-2\)](#) «Дорожная карта по бесшовной Глобальной системе обработки данных и прогнозирования с новым названием Глобальной системы обработки данных и прогнозирования»;
- 5) [рекомендацию 24 \(ИНФКОМ-2\)](#) «Поправки к *Наставлению по Глобальной системе обработки данных и прогнозирования (ВМО-№ 485)* в соответствии с Единой политикой ВМО в области данных»;
- 6) [резолюцию 27 \(Кг-19\)](#) «Поправки к *Наставлению по Глобальной системе обработки данных и прогнозирования (ВМО-№ 485)* в соответствии с Единой политикой ВМО в области данных»;
- 7) решение 19 (СЕРКОМ-3) «Предлагаемые поправки к *Наставлению по КСОПВ*, касающиеся параметров тропических циклонов»,

вновь подтверждая:

- 1) что Единая политика ВМО в области данных гласит, что основные данные должны предоставляться на безвозмездной и неограниченной основе, что необходимо для предоставления обслуживания в поддержку защиты жизни;
- 2) что обязательная продукция региональных специализированных метеорологических центров (РСМЦ) для глобального детерминистского численного прогнозирования погоды (ЧПП) и глобального ансамблевого ЧПП рассматривается в качестве основных данных в [Наставлении по Комплексной системе обработки и прогнозирования ВМО \(ВМО-№ 485\)](#), дополнение IV к Техническому регламенту ВМО,

признавая, что в [Техническом регламенте](#) (ВМО-№ 49), том I — Общие метеорологические стандарты и рекомендуемые практики, [Наставлении по Комплексной системе обработки и прогнозирования ВМО \(ВМО-№ 485\)](#) и [Руководстве по Комплексной системе обработки и прогнозирования ВМО \(ВМО-№ 305\)](#) было введено название Комплексной системы обработки и прогнозирования ВМО (КСОПВ) вместо названия «Глобальная система обработки данных и прогнозирования (ГСОДП)»,

отмечая:

- 1) что Постоянный комитет по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля (ПК-МПСЗ) дополнительно обновил перечень обязательной и рекомендуемой продукции РСМЦ для ЧПП с учетом итогов симпозиума ГСОДП по требованиям к данным и продуктам ЧПП (август 2022 г., Женева, Швейцария);
- 2) что Конгресс ВМО поручил ИНФКОМ дать четкие определения «обязательной продукции» и «настоятельно рекомендуемой продукции» в *Наставлении по КСОПВ*;
- 3) что Комиссия по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) предложила ИНФКОМ рассмотреть целесообразность использования названия «РСМЦ» в качестве общего названия для региональных центров, которые охватывают деятельность во всех областях системы Земля;

- 4) что ПК-МПСЗ приступил к пересмотру и обновлению стандартизированных методов проверки продукции детерминистского и ансамблевого ЧПП с учетом новой предложенной обязательной продукции, как сообщается в документе INFCOM-3/INF.8.4(1a);
- 5) что ПК-ПМСЗ начал первый цикл обзора соответствия центров КСОПВ и завершил обзор соответствия РСМЦ для глобального детерминистского и ансамблевого ЧПП, как сообщается в [решении 1 \(ИНФКОМ-3\)](#) «Доклад президента Комиссии, в том числе доклады председателей вспомогательных органов»;
- 6) ПК-ПМСЗ оценил технические возможности центров, подавших заявление на назначение в качестве центров КСОПВ,

признавая, что Экспертная группа по оперативной системе прогнозирования погоды (ЭГ-ОСПП) ПК-МПСЗ разработала перечень продукции ЧПП в виде переменных вихря тропической депрессии/циклона в тесном сотрудничестве с Консультативной группой по тропическим циклонам при СЕРКОМ и Всемирной программой метеорологических исследований (ВПМИ) по продукции вероятностного прогнозирования тропических циклонов (ПВП-ТЦ),

изучив следующий проект поправок к [Наставлению по Комплексной системе обработки и прогнозирования ВМО](#) (ВМО-№ 485), которые предложил ПК-МПСЗ:

- 1) введение определения трех категорий деятельности: деятельности общего назначения, специализированной деятельности и деятельности не в реальном масштабе времени — в соответствии с дополнением 1 к проекту резолюции №№/1 (ИС-78);
- 2) изменение общего названия назначенных центров КСОПВ с «региональный специализированный метеорологический центр (РСМЦ)» и «сеть РСМЦ» на «назначенный центр Комплексной системы обработки и прогнозирования ВМО (КСОПВ) (НЦ-КСОПВ)» и «сеть центров КСОПВ» соответственно, при этом «РСМЦ» сохраняется в качестве другого названия «НЦ-КСОПВ», в соответствии с дополнением 1 к проекту резолюции №№/1 (ИС-78);
- 3) объединение терминов «настоятельно рекомендуемая продукция», «дополнительная рекомендуемая продукция» и «дополнительная настоятельно рекомендуемая продукция» в термин «рекомендуемая продукция»;
- 4) введение определения «обязательной продукции» и «рекомендуемой продукции», в соответствии с дополнением 1 к проекту резолюции №№/1 (ИС-78);
- 5) пересмотренный перечень обязательной и рекомендуемой продукции РСМЦ для глобального детерминистского ЧПП, включая продукцию в виде переменных вихря тропической депрессии/циклона, в соответствии с дополнением 2 к проекту резолюции №№/1 (ИС-78);
- 6) пересмотренный перечень обязательной и рекомендуемой продукции РСМЦ для глобального ансамблевого ЧПП, включая продукцию в виде переменных вихря тропической депрессии/циклона, в соответствии с дополнением 3 к проекту резолюции №№/1 (ИС-78);
- 7) классификация обязательной продукции РСМЦ для детерминистского и ансамблевого ЧПП по ограниченному району как «основных данных» в соответствии с дополнением 4 к проекту резолюции №№/1 (ИС-78);

- 8) пересмотренный перечень обязательной и рекомендуемой продукции РСМЦ для детерминистского ЧПП по ограниченному району в соответствии с дополнением 5 к проекту резолюции №№/1 (ИС-78);
- 9) пересмотренный перечень обязательной и рекомендуемой продукции РСМЦ для ансамблевого ЧПП по ограниченному району в соответствии с дополнением 6 к проекту резолюции №№/1 (ИС-78),

изучив далее назначение центра КСОПВ в Вашингтоне в качестве РСМЦ для глобального ансамблевого ЧПП и его включение в часть III *Наставления по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485),

рекомендует Исполнительному совету принять поправки к *Наставлению по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485) посредством проекта резолюции, представленного в дополнении к настоящей рекомендации.

Примечание: настоящая рекомендация заменяет [рекомендацию 23 \(ИНФОМ-2\)](#) «Дорожная карта по бесшовной Глобальной системе обработки данных и прогнозирования с новым названием Глобальной системы обработки данных и прогнозирования», которая более не имеет силы.

Дополнение к рекомендации 9 (ИНФОМ-3)

Проект резолюции №№/1 (ИС-78)

Поправки к Наставлению по Комплексной системе обработки и прогнозирования ВМО (ВМО-№ 485) для прогнозирования погоды

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на:

- 1) [резолюцию 18 \(ИС-69\)](#) «Пересмотренное Наставление по Глобальной системе обработки данных и прогнозирования (ВМО-№ 485)»;
- 2) [резолюцию 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля»;
- 3) [резолюцию 27 \(Кг-19\)](#) «Поправки к Наставлению по Глобальной системе обработки данных и прогнозирования (ВМО-№ 485) в соответствии с Единой политикой ВМО в области данных»,
- 4) [резолюцию 42 \(ИС-76\)](#) «Поправки к Правилам процедуры для технических комиссий (ВМО-№ 1240)»,

изучив рекомендацию 9 (ИНФОМ-3) «Поправки к *Наставлению по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485) для прогнозирования погоды»,

учитывая, что термины «региональный специализированный метеорологический центр (РСМЦ)» и «сеть РСМЦ» используются в *Техническом регламенте* (ВМО-№ 49), наставлениях и руководствах,

учитывая далее, что некоторые виды деятельности Комплексной системы обработки и прогнозирования ВМО (КСОПВ), подпадающие под категорию «специализированные виды деятельности», которые обеспечивают руководящие указания, основанные на интерпретации человеком, предназначенные для конкретного типа применения или

сообщества пользователей, представляют общий интерес для обеих технических комиссий с точки зрения их соответствующих мандатов,

согласовав:

- 1) поправки к *Наставлению по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485) с целью унификации терминологии, связанной с рекомендуемой продукцией, и терминов, приведенных в дополнениях с 1 по 6 к настоящей резолюции, за исключением назначения центров, с вступлением в силу с 1 марта 2025 года;
- 2) поправки к *Наставлению по Комплексной системе обработки и прогнозированию ВМО* (ВМО-№ 485), касающиеся назначения центра КСОПВ в Вашингтоне в качестве регионального специализированного метеорологического центра (РСМЦ) для глобального ансамблевого численного прогнозирования погоды (ЧПП), с вступлением в силу с 1 сентября 2024 года,

призывает Членов, на территории которых размещаются РСМЦ для глобального детерминистского ЧПП, глобального ансамблевого ЧПП, детерминистского ЧПП по ограниченному району и ансамблевого ЧПП по ограниченному району, произвести и предоставить всю обязательную продукцию и по возможности рекомендуемую продукцию как можно скорее, но не позднее 1 марта 2027 года;

призывает далее Членов прилагать усилия для назначения РСМЦ, проводящих детерминистские и ансамблевые ЧПП по ограниченному району, чтобы охватить те районы, которые не охватывают существующие РСМЦ для ЧПП по ограниченному району;

порукает Комиссии по наблюдениям, инфраструктуре и информационным системам:

- 1) пересмотреть и обновить стандартизированные методы проверки продукции детерминистского и ансамблевого ЧПП с учетом обновленной обязательной продукции РСМЦ для глобальных детерминистских и ансамблевых ЧПП;
- 2) предоставить руководство Членам, на территории которых размещаются РСМЦ для глобального детерминистского ЧПП, глобального ансамблевого ЧПП, детерминистского ЧПП по ограниченному району и ансамблевого ЧПП по ограниченному району, чтобы сделать их продукцию ЧПП доступной в ИСВ 2.0;
- 3) пересмотреть и обновить процедуру разработки функций и критериев существующих и новых типов РСМЦ в категории «специализированные виды деятельности», чтобы обеспечить их соответствие потребностям Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ);

уполномочивает Генерального секретаря в консультации с президентом ИНФОМ:

- 1) внести редакционные поправки в *Наставление по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485), включая поправки, касающиеся замены терминологии, связанной с «рекомендуемой продукцией»;
- 2) заменить названия «региональный специализированный метеорологический центр (РСМЦ)» и «сеть РСМЦ» на «назначенный центр Комплексной системы обработки и прогнозирования ВМО (КСОПВ) (НЦ-КСОПВ)» и «сеть центров КСОПВ» соответственно, по мере необходимости в публикациях ВМО, включая *Технический регламент* (ВМО-№ 49), наставления и руководства.

Более подробную информацию см. в документе INFCOM-3/INF. 8.4(1a).

Дополнение 1 к проекту резолюции №№/1 (ИС-78)

*[Proposed amendments are highlighted in **addition** or ~~deletion~~ to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]*

PART I. OUTLINE OF THE WMO INTEGRATED PROCESSING AND PREDICTION SYSTEM

1.1 PURPOSE AND SUPPORTED ACTIVITIES

1.1.1 General description

1.1.1.1 WIPPS shall be the worldwide network of operational centres operated by WMO Members. Its purpose shall be to make operationally available among WMO Members and relevant operational organizations defined products and services for applications related to weather, climate, water and environment.

1.1.1.2 WIPPS shall enable scientific and technological advances made in meteorology and related fields to be accessible and exploitable by WMO Members.

1.1.1.3 The activities, organizational structure and operations of WIPPS shall be systematically designed in accordance with Members' needs and their ability to contribute to, and benefit from, the system in an efficient manner and with a minimum of duplication.

1.1.1.4 A key objective of WIPPS should be to facilitate cooperation and the exchange of information, thereby also contributing to capacity development among developing countries.

1.1.1.5 Defined products and services for applications related to weather, climate, water and environment shall include:

- (a) Numerical weather, oceanographic and climate prediction products (analysis and forecast, including probabilistic information);**
- (b) Specialized products tailored for specific applications.**

1.1.1.6 Additional information necessary for an appropriate use of the identified products and services shall be available. This includes non-real-time information as follows:

- (a) Systems description and characteristics;**
- (b) Product metadata;**
- (c) Verification and monitoring results.**

1.1.2 Activities supported by the WMO Integrated Processing and Prediction System

1.1.2.1 Through WIPPS, Members shall provide and have access to meteorological, hydrological, oceanographic and climatological information supporting a range of operational activities.

1.1.2.2 WIPPS shall be organized as a ~~three-tier~~ system ~~of activities with three~~ **activity categories as follows:**

- (a) General-purpose activities are those that provide real-time analyses and predictions required for a wide range of end use,**
- (b) Specialized activities are those that make forecasting products, ~~which may include guidance based on human interpretation~~, tailored for a specific type of application or user community (e.g. guidance based on human interpretation),**
- (c) Non-real-time coordination activities are those that provide consistent presentations of results of verification and monitoring needed for appropriate use of WIPPS products, while not providing real-time forecasts, ~~do provide additional information needed for appropriate use of WIPPS, such as verification of WIPPS products.~~**

Note: ~~A distinction is made between general purpose and specialized activities: general purpose activities are those that encompass essential data processing required for a wide range of end use, while specialized activities are those that make forecasting products, which may include guidance based on human interpretation, tailored for a specific type of application or user community. In addition to these activities conducted in real time, non-real time operational coordination activities are also part of WIPPS.~~ Associated commitments and other appropriate details are specified in Part II.

1.1.2.3 WIPPS shall be organized with the activities as follows:

(a) General-purpose activities:

- Global deterministic NWP
- Limited-area deterministic NWP
- Global ensemble NWP
- Limited-area ensemble NWP
- Global numerical sub-seasonal forecasts (SSFs)
- Global numerical long-range prediction
- Annual to decadal climate prediction
- Numerical ocean wave prediction
- Global numerical ocean prediction
- Nowcasting
- Sub-seasonal to seasonal hydrological prediction
- Snow cover prediction

(b) Specialized activities:

- Regional climate prediction and monitoring
- Coordination of multi-model ensembles for sub-seasonal forecasts
- Coordination of multi-model ensemble prediction for long-range forecasts (LRFs)
- Coordination of annual to decadal climate prediction
- Regional severe weather forecasting
- Tropical cyclone forecasting, including marine-related hazards
- Nuclear environmental emergency response
- Non-nuclear environmental emergency response
- Atmospheric sand and dust storm forecasts
- Volcano watch services for international air navigation
- Marine meteorological services
- Marine environmental emergency response
- Flash flood forecasting

(c) Non-real-time ~~coordination~~ coordination activities:

- Coordination of deterministic NWP verification (DNV)
- Coordination of Ensemble Prediction System (EPS) verification
- Coordination of wave forecast verification (WV)
- Coordination of tropical cyclone forecast verification (TCV)

– Coordination of observation monitoring

Note: It is hoped that other activities, including those related to hydrology, agriculture, polar regions, storm-surge prediction, and space weather, will be developed in future.

1.2 WMO INTEGRATED PROCESSING AND PREDICTION SYSTEM CENTRES

1.2.1 Definitions

1.2.1.1 The meteorological forecasting ranges shall be those defined in Appendix 1.1.

1.2.1.2 WIPPS shall be organized as a three-level system of World Meteorological Centres (WMCs), WIPPS Designated Centres (WIPPS-DC) ~~Regional Specialized Meteorological Centres (RSMCs)~~ and National Meteorological Centres (NMCs), which carry out WIPPS functions at the global, regional and national levels, respectively. These centres are referred to as WIPPS centres.

1.2.2 National Meteorological Centres

1.2.2.1 An NMC shall carry out functions to meet the national and international requirements of the Member concerned.

Note: To fulfil their national and international obligations, NMCs need to be adequately staffed and equipped to enable them to participate effectively in the World Weather Watch system.

1.2.2.2 The functions of an NMC shall include the preparation of forecasts and warnings at all forecasting ranges necessary to meet the requirements of the Member.

1.2.2.3 Depending on the context, other activities of an NMC should include the production of:

- (a) Special-application products, including climate and environmental quality monitoring and prediction products;
- (b) Non-real-time climate-related products.

1.2.3 WMO Integrated Processing and Prediction System Designated Centres ~~Regional Specialized Meteorological Centres~~

1.2.3.1 A Member, having accepted the responsibility for providing a WIPPS Designated Centre (WIPPS-DC) ~~RSMC~~, shall arrange for this centre to carry out operationally at least one of the ~~general-purpose or specialized~~ activities listed in 1.1.2.32, for which specified standards are described in Part II.

1.2.3.2 A WIPPS-DC ~~RSMC~~ for general-purpose activities should provide products that a WIPPS-DC ~~RSMC~~ carrying out at least one of the specialized activities considers necessary and makes a request to produce.

1.2.3.3 Defined products of a WIPPS-DC shall be categorized as mandatory products and recommended products defined as follows:

(a) Mandatory products shall be the products that the WIPPS-DC is required to produce and provide to fulfil its obligation as a WIPPS-DC. The list of mandatory products shall be defined in the Manual.

(b) Recommended products shall be the products that, while not mandatory, the WIPPS-DC is strongly encouraged to provide to support other WIPPS-DCs and Members. The list of recommended products shall be defined in the Manual.

1.2.3.4 Products that are necessary for the provision of services in support of the protection of life and property and for the well-being of all nations and are classified as "core data" shall be labelled as "core data" explicitly in the Manual.

Notes:

1. A WIPPS-DC can be also referred to as a Regional Specialized Meteorological Centre (RSMC) as appropriate.
2. The designation as WIPPS-DC RSMC does not preclude the use of other names as defined in other contexts, for example, Global Producing Centre for Long-range Forecasts (GPC-LRF).
3. A WIPPS-DC RSMC that leads a coordination activity is also referred to as a Lead Centre.
4. The definition of core data is described in the WMO Unified Data Policy, Resolution 1 (Cq-Ext. (2021)).

1.2.4 World Meteorological Centres

A Member, having accepted the responsibility for providing a WMC, shall arrange for this centre to carry out operationally at least the following activities, for which specified standards are described in Part II:

- (a) Global deterministic NWP;**
- (b) Global ensemble NWP;**
- (c) Global numerical long-range prediction.**

1.2.5 WMO Integrated Processing and Prediction System ~~Regional Specialized Meteorological~~ Centre Networks

1.2.5.1 ~~An WIPPS Centre RSMC~~ Network (an association of WIPPS-DCs ~~RSMCs~~ participating in an identified activity of WIPPS) shall follow the same specifications and adhere to the same criteria and commitments as individual WIPPS-DCs ~~RSMCs~~ carrying out the same activity.

1.2.5.2 Appropriate documentation shall be produced and made available by Members having accepted the responsibility to contribute to the WIPPS Centre ~~RSMC~~ Network to distribute the tasks and responsibilities among the participating WIPPS-DCs ~~RSMCs~~. A unique focal point shall be designated to answer requests from users of the WIPPS Centre ~~RSMC~~ Network products.

1.2.6 Designation process

1.2.6.1 Each Member shall designate an NMC.

1.2.6.2 The WMCs, WIPPS-DCs ~~RSMCs~~ and WIPPS Centre ~~RSMC~~ Networks shall be designated by a decision of the World Meteorological Congress or the WMO Executive Council. The designation of such centres shall include the specification of the activity and function (or activities and functions) to be carried out.

1.2.6.3 Requests for designation as a WMC or WIPPS-DC ~~RSMC~~ shall be put forward by the Permanent Representative of the Member of the candidate centre, or, in the case of international organizations, by either the Permanent Representative of the country where the candidate centre is located or the president of the relevant regional association(s) (RA(s)).

Note: The Permanent Representative of the Member consults with the Hydrological Adviser with respect to requests for designation as a centre relevant to operational hydrology and its application to water management, as per Regulation 5 of General Regulations, ([Basic documents](#) (WMO-No. 15)).

1.2.6.4 Requests for designation as an [WIPPS Centre](#) ~~RSMC~~ Network shall be put forward by the president of the relevant RA, or, in the case of networks established across two or more RAs, jointly by their presidents.

Note: Centres constituting a network will organize themselves as appropriate, depending on their own context and specificities, so as to ensure that the documentation requested as per paragraph 1.2.5.2 is available.

1.2.6.5 Requests for designation shall be addressed to the WMO Secretariat, which will forward them to the relevant constituent bodies as indicated in Tables 2–29 in Part II of the present Manual. Supporting information demonstrating compliance with designation criteria shall be included with the request.

1.2.6.6 Depending on the type of activity, endorsement by the RA(s) and technical commission(s) should be required before designation by the World Meteorological Congress or WMO Executive Council.

1.3 COORDINATION WITH OTHER SYSTEMS OR PROGRAMMES

WIPPS shall support all WMO Programmes and related programmes of other international organizations in accordance with decisions of the Organization.

Notes:

1. In many cases the activities undertaken by WIPPS centres constitute the operational component of a system developed under another structure or programme, either by WMO on its own or jointly with other international organizations. In such cases the regulations pertaining to these activities cover both:
 - (a) The specific requirements defined by the relevant structure;
 - (b) The general WIPPS criteria regarding operational quality and reliability, verification, documentation and compliance (described in Part II of the present Manual).
2. Coordination mechanisms appropriate for the context and characteristics of the various categories of activity are specified in Part II.

Дополнение 2 к проекту резолюции №№/1 (ИС-78)

[Proposed amendments are highlighted in [addition](#) or ~~deletion~~ to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

APPENDIX 2.2.1. MANDATORY AND ~~HIGHLY~~ RECOMMENDED GLOBAL DETERMINISTIC NUMERICAL WEATHER PREDICTION PRODUCTS TO BE MADE AVAILABLE ON THE WMO INFORMATION SYSTEM

[1. NWP gridded products](#)

[Mandatory products:](#)

<i>Parameter</i>	<i>Level (hPa)</i>	<i>Resolution</i>	<i>Forecast range</i>	<i>Time steps</i>	<i>Frequency</i>

1. Wind gusts are the maximum gusts in the periods of the last 3/6 hours.
2. Water equivalent of total solid precipitation, where possible, is the combination of snow and graupel (ice pellets).
3. Recommended most unstable CAPE (MUCAPE). RSMC is required to provide information on which type of CAPE is provided in the model characteristics web page.

- More fields describing precipitation type
- Mid-level CAPE
- 1-hour accumulated total precipitation
- Snow depth

- Divergence and vorticity (925/850/700/500/250/200 hPa)
- Downward solar radiation at surface
- Outgoing longwave radiation at the top of atmosphere
- Heatwave Index
- Wind u and v at additional heights of 80 m, 100 m, 120 m, or 150 m above ground
- Option to access high-resolution data (up to full model resolution).
- Provide data additionally in form of map layers, graphics, or visualization.

2. Tropical low/cyclone vortex variables

Vortices of tropical cyclones that exist at analysis time or form in the forecast time range should be tracked and included in the parameter file. In this context, tropical cyclone is a generic term for a non-frontal synoptic scale low pressure system which has a cyclone wind circulation. The recommended criteria can be found in the guidelines. If a track has a fix at analysis time and can be associated with an analysis position from RSMCs for tropical cyclone forecasting, then the track shall have the RSMCs identifier and name (if it is named).

Mandatory Products:

<i>Parameter</i>	<i>Unit</i>	<i>Forecast range</i>	<i>Time steps</i>	<i>Frequency</i>
<u>Location (latitude and longitude) of the vortex centre</u>	[degree]	<u>Up to 6 days³</u>	<u>Every 6 hours</u>	<u>Twice a day⁴</u>
<u>Maximum sustained 10 m wind speed</u>	[m/s]			
<u>Location¹ (latitude and longitude) of maximum sustained 10 m wind</u>	[degree]			
<u>Minimum mean sea level pressure (MSLP)</u>	[hPa]			
<u>Quadrant radii of sustained 10 m winds of 28/34/50²/64 kt</u>	[km]			

Notes:

1. Recommended procedures to calculate the location of maximum wind is provided at section x.x.x of the Guide to WIPPS (WMO-No. 305).
2. The Centre can provide the quadrant radii for 48kt winds instead of the quadrant radii for 50kt winds.
3. Beyond about 6 days users are highly recommended to use ensemble data and only to use the deterministic as an additional ensemble member.
4. It is **strongly** recommended to provide all mandatory products four times a day or more frequently and with time steps of every 3 hours.

Recommended Products:

<i>Parameter</i>	<i>Unit</i>	<i>Forecast range</i>	<i>Time steps</i>	<i>Frequency</i>
<u>Average steering wind zonal velocity (u) and meridional velocity (v)¹ at 850/500/200 hPa</u>	[m/s]	<u>Up to 6 days²</u>	<u>Every 6 hours</u>	<u>Twice a day³</u>

Note:

1. Recommended procedures to calculate average steering wind is provided at section x.x.x of the [Guide to WIPPS](#) (WMO-No. 305)
2. Beyond about 6 days, users are recommended to use ensemble data and only to use the deterministic as an additional ensemble member.
3. It is **strongly** recommended to provide all recommended products four times a day or more frequently.

APPENDIX 2.2.2. CHARACTERISTICS OF GLOBAL DETERMINISTIC NUMERICAL WEATHER PREDICTION SYSTEMS

1. System

- System name (version):
- Date of implementation:

2. Configuration

- Horizontal resolution of the model, with indication of grid spacing in km:
- Number of model levels:
- Top of model:
- Forecast length and forecast step interval:
- Runs per day (times in UTC):
- Is model coupled to ocean, wave, sea-ice models? Specify which models:
- Integration time step:
- Additional comments:

3. Initial conditions

- Data assimilation method:
- Additional comments:

4. Surface boundary conditions

- Sea-surface temperature? If yes, briefly describe method(s):
- Land-surface analysis? If yes, briefly describe method(s):
- Additional comments:

5. Other details of model

- What kind of soil scheme is in use?
- How are radiations parameterized?
- What kind of large-scale dynamics is in use (for example, grid-point semi-Lagrangian)? Hydrostatic or non-hydrostatic?
- What kind of boundary layer parameterization is in use?
- What kind of convection parameterization is in use?
- What cloud scheme is in use?
- Other relevant details?

6. Products

- Method of the calculation of mandatory and recommended products, especially e.g. those of tropical low/cyclone vortex, if the method is not unique:
- Definition of tropical cyclone in numerical model output:
- Other detailed specifications, if necessary:

6. Further information

- Operational contact point:
 - URLs for system documentation:
 - URL for list of products:
-

Дополнение 3 к проекту резолюции №№/1 (ИС-78)

[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

APPENDIX 2.2.5. MANDATORY AND ~~HIGHLY~~ RECOMMENDED GLOBAL ENSEMBLE PREDICTION SYSTEM PRODUCTS TO BE MADE AVAILABLE ON THE WMO INFORMATION SYSTEM

1. NWP gridded products

Mandatory products:

Parameter	Level ~~(hPa)~~	Thresholds ¹	Resolution (lat/lon grid)	Forecast range	Time steps	Frequency
Probability of total precipitation in the last 6 hours and 24 hours	Surface	1, 5, 10, 25, 50 and 100 mm/24 hours; 1, 5, 10, 25 and 50 mm/6 hours	~~1.50.5°~~ × ~~1.50.5°~~	~~10~~ 14 days (or the maximum range if less)	~~Every 12 hours~~ Every 3 hours to 72 hours, then every 6 hours.	~~Once~~ Twice a day
Percentiles for total precipitation in the last 6 hours and 24 hours	Surface	25th, 50th, 75th, max				
Percentiles for total solid precipitation ² in the last 6 hours	Surface	25th, 50th, 75th, max				
Percentiles for temperature	2 m, 850 hPa	min, 25th, 50th, 75th, max				
Probability of 10-m sustained wind ~~and gusts~~	~~Surface~~ 10 m	10, 15, ~~20~~ and 25 m s ⁻¹				
Probability of 10-m wind gusts ³	10 m	15, 25 and 35 m s⁻¹				
Percentiles for 10-m wind speed	10 m, 850 hPa, 250 hPa	min, 25th, 50th, 75th, max				
Percentiles for 10-m wind gusts ³	10 m	min, 25th, 50th, 75th, max				
Percentiles for CAPE ⁴	Surface	25th, 50th, 75th, max				
Percentiles for magnitude of wind shear	Vector difference	min, 25th, 50th, 75th, max				

	between 250 and 850 hPa Vector difference between 700 and 925 hPa					
Percentiles for total cloud cover	Surface	min, 25th, 50th, 75th, max				
Probability of temperature anomalies	850	~~±1, ±1.5, ±2 standard deviations with respect to a reanalysis climatology specified by the Producing Centre~~				
Ensemble mean + spread (standard deviation) of geopotential height	500 hPa					
Ensemble mean + spread (standard deviation) of mean sea level pressure (MSLP)	Surface					
~~Ensemble mean + spread (standard deviation) of wind speed~~	~~850/250~~					

Notes:

1. The maximum and minimum percentiles should be represented by an extreme percentile. The most appropriate percentile depends on the configuration of the NWP model and any post-processing and is to be chosen by the Producing Centre;
2. Water equivalent of total solid precipitation, where possible, is the combination of snow and graupel (ice pellets);
3. Wind gusts are the maximum gusts in the periods of the last 3/6 hours;
4. Recommended most unstable CAPE (MUCAPE). RSMC is required to provide information on which type of CAPE is provided in the model characteristics web page.

~~Additional highly recommended products:~~

- Location specific time series of temperature, precipitation, wind speed, depicting the most likely solution and an estimation of uncertainty ("EPSgrams"); the definition, method of calculation and the locations should be documented;
- ~~----- Tropical storm tracks (latitude/longitude locations, maximum sustained wind speed, MSLP from EPS members);~~
- == Provide data additionally in form of high-resolution map layers, graphics, or visualization.
- == Option to access high-resolution data (up to full model resolution)
- == Options to access additional percentile values and probability thresholds
- == Option to access all ensemble members

- Probability of temperature anomalies, at 850 hPa, for ± 1 , ± 1.5 , ± 2 standard deviations with respect to a reanalysis climatology specified by the Producing Centre
- Percentiles of the following variables:
 - Mid-level CAPE
 - 1-hour or 3-hour accumulated total precipitation
 - Snow depth, Snow Water Equivalent (SWE)
 - Heat wave index
 - Wind u and v at additional heights 80 m, 100 m, 120 m or 150 m above ground

2. Tropical low/cyclone vortex variables

Vortices for significant tropical systems that exist at analysis time or form in the forecast time range should be tracked and included in the parameter file. If a track has a fix at analysis time and can be associated with an analysis position from RSMCs for tropical cyclone forecasting, then the track should have the RSMCs identifier and name (if named).

The Centre is requested to produce the following listed parameters from all ensemble members of the global ensemble system.

Mandatory Products:

<i>Parameter</i>	<i>Unit</i>	<i>Forecast range</i>	<i>Time steps</i>	<i>Frequency</i>
Location (latitude and longitude) of the vortex centre	[degree]	14 days (or the maximum range if less)	Every 6 hours	Twice a day ³
Maximum sustained 10 m wind speed	[m/s]			
Location ¹ (latitude and longitude) of maximum sustained 10 m wind	[degree]			
Minimum mean sea level pressure (MSLP)	[hPa]			
Quadrant radii of sustained 10 m-winds of 28/34/50 ² /64 kt	[km]			

Notes:

1. Recommended procedures to calculate the location of maximum wind is provided at section x.x.x of the [Guide to WIPPS](#) (WMO-No. 305);
2. The Centre can provide the quadrant radii for 48kt winds instead of the quadrant radii for 50kt winds;
3. It is ~~strongly~~ recommended to provide all mandatory products four times a day or more frequently, and with time steps of every 3 hours.

Recommended Products:

<i>Parameter</i>	<i>Unit</i>	<i>Forecast range</i>	<i>Time steps</i>	<i>Frequency</i>
Average steering wind zonal velocity (u) and meridional velocity (v) ¹ at 850/500/200 hPa	[m/s]	14 days (or the maximum range if less)	Every 6 hours	Twice a day ²

Note:

1. Recommended procedures to calculate average steering wind is provided at section x.x.x of the [Guide to WIPPS](#) (WMO-No. 305)
2. It is ~~strongly~~ recommended to provide all recommended products four times a day or more frequently.

APPENDIX 2.2.6. CHARACTERISTICS OF THE GLOBAL ENSEMBLE PREDICTION SYSTEM

1. Ensemble system

- Ensemble name (version):
- Date of implementation:

2. Configuration of the Ensemble Prediction System

- Horizontal resolution of the model, with indication of grid spacing in km:
- Number of model levels:
- Top of model:
- Forecast length and forecast step interval:
- Runs per day (times in UTC):
- Is there an unperturbed control forecast included?
- Number of perturbed ensemble members (excluding control):
- Is model coupled to ocean, wave, sea-ice models? Specify which models:
- Integration time step:
- Additional comments:

3. Initial conditions and perturbations

- Initial perturbation strategy:
- Optimization time in forecast (if applicable):
- Horizontal resolution of perturbations (if different from model resolution):
- Initial perturbed area:
- Data assimilation method for control analysis:
- Are perturbations to observations employed? If so, which observation types are perturbed?
- Perturbations added to control analysis or derived directly from ensemble analysis:
- Perturbations in +/- pairs?
- Additional comments:

4. Model uncertainty perturbations

- Is model physics perturbed? If so, briefly describe method(s):
- Do all ensemble members use exactly the same model version, or are, for example, different parameterization schemes used? Please describe any differences:
- Is model dynamics perturbed? If so, briefly describe method(s):
- Are the above model uncertainty perturbations applied to the control forecast?
- Additional comments:

5. Surface boundary perturbations

- Perturbations to SST? If so, briefly describe method(s):
- Perturbations to soil moisture? If so, briefly describe method(s):
- Perturbations to surface wind stress or roughness? If so, briefly describe method(s):
- Any other surface perturbations? If so, briefly describe method(s):
- Are the above surface perturbations applied to the control forecast?
- Additional comments:

6. Other details of model

- What kind of soil scheme is in use?
- How are radiations parameterized?

- What kind of large-scale dynamics is in use (for example, grid-point semi-Lagrangian)? Hydrostatic or non-hydrostatic?
- What kind of boundary layer parameterization is in use?
- What kind of convection parameterization is in use?
- What cloud scheme is in use?
- Other relevant details?

7. Products

- Method of the calculation: ~~of mandatory and recommended products, especially e.g. those of tropical low/cyclone vortex,~~ if the method is not unique:
- Definition of tropical cyclone in numerical model output:
- Other detailed specifications, if necessary:

8. Further information

- Operational contact point:
- URLs for system documentation:
- URL for list of products:

Дополнение 4 к проекту резолюции №№/1 (ИС-78)

*[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]*

2.2.1.2 Limited-area deterministic numerical weather prediction

Centres conducting limited-area deterministic NWP shall:

- (a) Produce limited-area analyses of the three-dimensional structure of the atmosphere;**
- (b) Produce limited-area forecast fields of basic and derived atmospheric parameters;**
- (c) Make available on WIS a range of these products; the list of mandatory **products (considered as core data)** and **highly** recommended limited-area deterministic NWP products to be made available, including metadata, is given in Appendix 2.2.3;**
- (d) Produce verification statistics according to the standard defined in Appendix 2.2.34, adapted for the region covered by the model, at an appropriate resolution, and make available consistent up-to-date graphical displays of the verification results on a website;**
- (e) Make available on a website up-to-date information on the characteristics of their limited-area NWP systems; the minimum information to be provided is given in Appendix 2.2.4.**

Note:

1. The definition of core data is provided in Resolution 1 (Cg-Ext(2021)).

2. The bodies in charge of managing the information contained in the present Manual related to limited-area deterministic NWP are specified in the table below.

2.2.1.4 Limited-area ensemble numerical weather prediction

Centres conducting limited-area ensemble NWP shall:

- (a) Produce limited-area ensemble forecast fields of basic and derived atmospheric parameters;
- (b) Make available on WIS a range of these products; the list of mandatory **products (considered as core data)** and **highly** recommended limited-area ensemble NWP products to be made available is given in Appendix 2.2.7;
- (c) Produce verification statistics according to the standard defined in Appendix 2.2.35, adapted for the region covered by the model, and make available consistent up-to-date graphical displays of the verification results on a website;
- (d) Make available on a website up-to-date information on the characteristics of their limited-area EPS; the minimum information to be provided is given in Appendix 2.2.8.

Notes:

1. The definition of core data is provided in Resolution 1 (Cg-Ext(2021)).

2. The bodies in charge of managing the information contained in the present Manual related to limited-area ensemble NWP are specified in the table below.

Дополнение 5 к проекту резолюции №№/1 (ИС-78)

[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

APPENDIX 2.2.3. MANDATORY AND **HIGHLY** RECOMMENDED LIMITED-AREA DETERMINISTIC NUMERICAL WEATHER PREDICTION PRODUCTS TO BE MADE AVAILABLE ON THE WMO INFORMATION SYSTEM

Mandatory Products:

Parameter	Level (hPa)	Resolution	Forecast range	Time steps	Frequency
Geopotential height	925/850/700/500/250	0.25° × 0.25°	2 ~~±~~ day	Every ~~36~~ hours (Every 1 hour for total and convective precipitation)	Twice a day
Temperature	925/850/700/500/250				
u, v	925/850/700/500/250				
Relative humidity	925/850/700/500				
Divergence, vorticity	925/850/700/500/250				
Mean sea level pressure (MSLP)	Surface				

<i>Parameter</i>	<i>Level (hPa)</i>	<i>Resolution</i>	<i>Forecast range</i>	<i>Time steps</i>	<i>Frequency</i>
2-m temperature <u>2-m dewpoint temperature</u> <u>2-m 3-hourly minimum and maximum temperature</u> 10-m u, 10-m v <u>10-m wind gust¹</u> Total precipitation (<u>1-hour accumulation</u>) <u>Convective precipitation (1-hour accumulation; where available)</u> <u>CAPE²</u> <u>Low and medium cloud coverage</u> <u>Total cloud coverage</u> <u>Precipitation type</u>					

Notes:

1. Wind gusts are the maximum gusts in the periods of the last 3 hours;
2. Recommended most unstable CAPE (MUCAPE). RSMC is required to provide information on which type of CAPE is provided in the model characteristics web page.

~~Additional~~ Recommended products:

- Vertical velocity (925, 850, 700, 500);
- ~~----- Cloud cover;~~
- Tropical storm tracks (latitudinal/longitudinal locations, maximum sustained wind speed, mean sea level pressure (MSLP)).
- ~~----- Convective inhibition (CIN)~~
- ~~----- 2-m Visibility~~
- ~~----- Lightning~~
- ~~----- Downward surface solar radiation~~
- ~~----- Surface UV~~

Дополнение 6 к проекту резолюции №№/1 (ИС-78)

[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

APPENDIX 2.2.7. MANDATORY AND ~~HIGHLY~~ RECOMMENDED LIMITED-AREA ENSEMBLE PREDICTION SYSTEM PRODUCTS TO BE MADE AVAILABLE ON THE WMO INFORMATION SYSTEM

Mandatory Products:

Parameter	Level ~~(hPa)~~	Thresholds	Resolution (lat/lon grid)	Forecast range	Time steps	Frequency
Probability of total precipitation	Surface	1, 5, 10, 25, 50 and 100 mm/24 hours 1, 5, 10, 25 and 50 mm/3 hours	0.25° × 0.25°	2 days (or the maximum range if less)	Every 36 hours	Once a day
Percentiles for total precipitation in the last 3 hours	Surface	25th, 50th, 75th, max				
Percentiles for temperature	2 m, 850 hPa	min, 25th, 50th, 75th, max				
Percentiles for dewpoint temperature	2 m	min, 25th, 50th, 75th, max				
Probability of 10-m sustained wind ~~and gusts~~	~~Surface~~ 10 m	10, 15, ~~20~~ and 25 m s ⁻¹				
Probability of 10-m wind gusts	10 m	15, 25 and 35 m s⁻¹				
Percentiles for wind speed	10 m	min, 25th, 50th, 75th, max				
Percentiles for wind gust (max during period)	10 m	25th, 50th, 75th, max				
Percentiles for CAPE	Surface	25th, 50th, 75th, max				
Percentiles for magnitude of wind shear	Vector difference between 250 and 850 hPa	min, 25th, 50th, 75th, max				
Percentiles for total cloud cover	Surface	min, 25th, 50th, 75th, max				

Additional highly recommended products:

- Location-specific time series of temperature, precipitation, wind speed, depicting the most likely solution and an estimation of uncertainty ("EPSgrams"); the definition, method of calculation and the locations should be documented;
- Tropical storm tracks (latitudinal/longitudinal locations, maximum sustained wind speed, mean sea level pressure (MSLP) from EPS members) where applicable;
- Probability of Lightning;
- Probability of 2 m Visibility;
- Ensemble mean and spread of MSLP and Geopotential height at 850, 700 and 500hPa.
- Percentiles of additional variables which might include:
 - Mid-level CAPE
 - 1-hour accumulated total precipitation
 - Downward surface solar radiation at surface
 - Outgoing longwave radiation at surface
 - Wind u and v at additional heights of 80 m, 100 m, 120 m or 150 m above ground
- Options to access high-resolution data (up to full model resolution), additional percentile values, probability thresholds and/or all ensemble members
- Provide data additionally in form of map layers, graphics, or visualization.

Рекомендация 10 (ИНФОМ-3)**Поправки к Наставлению по Комплексной системе обработки и прогнозирования ВМО (ВМО-№ 485) для прогнозирования климата**

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолуцию 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля»;
- 2) [резолуцию 26 \(ИС-76\)](#) «Назначение глобальных центров подготовки долгосрочных прогнозов, глобальных центров подготовки субсезонных прогнозов и ведущего центра, координирующего деятельность по субсезонному прогнозированию на основе мультимодельных ансамблей»;
- 3) [резолуцию 27 \(Кг-19\)](#) «Поправки к Наставлению по Глобальной системе обработки данных и прогнозирования (ВМО-№ 485) в соответствии с Единой политикой ВМО в области данных»,

вновь подтверждая:

- 1) что, как гласит Единая политика ВМО в области данных, основные данные должны предоставляться на безвозмездной и неограниченной основе, что необходимо для предоставления обслуживания в поддержку защиты жизни;
- 2) что обязательная продукция Глобального центра подготовки глобальных численных субсезонных прогнозов (ГЦП-ССП) и Глобального центра подготовки глобальных численных долгосрочных прогнозов (ГЦП-ДП) рассматривается в качестве основных данных в [Наставлении по Комплексной системе обработки и прогнозирования ВМО \(ВМО-№ 485\)](#),

отмечая:

- 1) острую потребность в данных реанализа климата, которые определены как основные данные в рамках нескольких дисциплин/областей системы Земля в Единой политике ВМО в области данных, для поддержки деятельности Членов ВМО в области мониторинга и прогнозирования климата, а также для понимания текущих экстремальных погодных явлений и изменений климата;
- 2) что Постоянный комитет по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля (ПК-МПСЗ) дополнительно обновил перечень обязательной и рекомендуемой продукции субсезонных прогнозов и долгосрочного прогнозирования с учетом итогов симпозиума Глобальной системы обработки данных и прогнозирования (ГСОДП) по требованиям к данным и продукции численного прогнозирования погоды (ЧПП) (август 2022 г., Женева, Швейцария);
- 3) что ПК-МПСЗ оценил технические возможности центров, подавших заявки на назначение в качестве центров Комплексной системы обработки и прогнозирования ВМО (КСОПВ),

отмечая далее, что Китай представил кандидатуру на назначение центра, осуществляющего реанализ глобального климата,

изучив следующий проект поправок к *Наставлению по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485), которые предложил ПК-МПСЗ:

- 1) создание двух видов новой деятельности в рамках КСОПВ: глобальный реанализ климата в качестве деятельности общего назначения и координация оценки реанализа климата на основе множественных данных в качестве специализированной деятельности — в соответствии с дополнением 1 и дополнением 7 к проекту резолюции №№/2 (ИС-78);
- 2) изменение структуры содержания деятельности в рамках КСОПВ по глобальным численным субсезонным прогнозам, глобальному численному долгосрочному прогнозированию, координации мультимодельных ансамблей для субсезонных прогнозов и координации мультимодельных ансамблей для долгосрочных прогнозов с целью улучшения удобства использования и разъяснения обязательных и рекомендуемых функций и продукции в соответствии с дополнениями 2, 3, 4 и 5 к проекту резолюции №№/2 (ИС-78);
- 3) введение вклада «содействующего центра» в деятельность в области КСОПВ по координации мультимодельных ансамблей для субсезонных прогнозов для обеспечения создания мультимодельного ансамбля в режиме реального времени, учитывая, что в настоящее время существует только один ГЦП-ССП, и включение предоставления карт, на которых представлено происхождение и активность тропических циклонов и другие переменные, в качестве рекомендуемой продукции в соответствии с дополнением 3 к проекту резолюции №№/2 (ИС-78);
- 4) снятие защиты паролем для загрузки цифровой продукции из Ведущего центра долгосрочного прогнозирования на базе мультимодельных ансамблей (ВЦ-ДПМА) и включение предоставления эквивалента талой воды и других переменных в качестве рекомендуемой продукции в соответствии с дополнением 5 к проекту резолюции №№/2 (ИС-78);
- 5) введение в качестве обязательной функции Ведущего центра подготовки годовых/десятилетних прогнозов климата (Ведущий центр для ПКГД) предоставления информационного бюллетеня по глобальному прогнозированию климата на период от года до десятилетия (ГПКГД-ИБ) в соответствии с дополнением 6 к проекту резолюции №№/2 (ИС-78);

- 6) назначение следующих центров КСОПВ в соответствии с дополнением 7 к проекту резолюции №№/2 (ИС-78):
 - а) центров, производящих глобальные численные субсезонные прогнозы: Бразилия (Центр прогнозирования погоды и проведения климатических исследований (ЦПТЕК)), Китай, Япония и Россия;
 - б) центров, производящих глобальный реанализ климата: США (Национальное управление по аэронавтике и исследованию космического пространства США (НАСА)) и Европейский центр среднесрочных прогнозов погоды (ЕЦСПП);
 - с) ведущего центра по координации оценки реанализа климата на основе множественных данных: ЕЦСПП;
- 7) изменение названия следующих видов деятельности в рамках КСОПВ для обеспечения согласованности субсезонных, сезонных, годовых и десятилетних прогнозов в *Наставлении по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485):
 - а) «глобальные численные субсезонные прогнозы» на «глобальное субсезонное прогнозирование»;
 - б) «глобальное численное долгосрочное прогнозирование» на «глобальное сезонное прогнозирование»;

изучив далее следующий проект поправок к *Наставлению по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485):

- 1) назначение сети арктических региональных климатических центров (АркРКЦ-Сеть), одобренное президентами региональных ассоциаций ВМО Регионов II, IV и VI и поддержанное президентом Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ), в соответствии с дополнением 7 к проекту резолюции №№/2 (ИС-78);
- 2) включение информации о связи Информационной системы климатического обслуживания (ИСКО) с КСОПВ в ответ на запрос Постоянного комитета по климатическому обслуживанию (ПК-КЛИ) при СЕРКОМ в соответствии с дополнением 8 к проекту резолюции №№/2 (ИС-78);

рекомендует Исполнительному совету принять поправки к *Наставлению по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485) посредством проекта резолюции, представленного в дополнении к настоящей рекомендации.

Дополнение к рекомендации 10 (ИНФОМ-3)

Проект резолюции №№/2 (ИС-78)

Поправки к *Наставлению по Комплексной системе обработки и прогнозирования ВМО* (ВМО-№ 485) для прогнозирования климата

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на:

- 1) [резолуцию 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля»;
- 2) [резолуцию 26 \(ИС-76\)](#) «Назначение глобальных центров подготовки долгосрочных прогнозов, глобальных центров подготовки субсезонных прогнозов и ведущего центра, координирующего деятельность по субсезонному прогнозированию на основе мультимодельных ансамблей»;
- 3) [резолуцию 27 \(Кг-19\)](#) «Поправки к *Наставлению по Глобальной системе обработки данных и прогнозирования* (ВМО-№ 485) в соответствии с Единой политикой ВМО в области данных»,

изучив [рекомендацию 10 \(ИНФКОМ-3\)](#),

согласовав:

- 1) поправки к [Наставлению по Комплексной системе обработки и прогнозирования ВМО](#) (ВМО-№ 485), касающиеся деятельности в рамках КСОПВ, как указано в дополнениях с 1 по 6 и дополнении 8 к настоящей резолюции, за исключением назначения центров, с вступлением в силу с 1 марта 2025 года;
- 2) поправки к [Наставлению по Комплексной системе обработки и прогнозирования ВМО](#) (ВМО-№ 485), касающиеся назначения центров КСОПВ, как указано в дополнении 7, с вступлением в силу с 1 сентября 2024 года,

признавая жизненно важный вклад содействующих центров, уже предоставляющих свои субсезонные прогнозы в режиме реального времени ведущему центру, координирующему деятельность по субсезонному прогнозированию на основе мультимодельных ансамблей (ВЦ-ССПМА), что позволяет Членам ВМО получать вероятностные субсезонные прогнозы,

призывает Членов, производящих субсезонные прогнозы в режиме реального времени, подавать заявки на назначение в качестве Глобальных центров подготовки субсезонных прогнозов (ЦП-ССП);

уполномочивает Генерального секретаря в консультации с соответствующим президентом Комиссии по наблюдениям, инфраструктуре и информационным системам (ИНФКОМ) внести редакционные поправки в [Наставление по Комплексной системе обработки и прогнозирования ВМО](#) (ВМО-№ 485), включая поправки, касающиеся изменения названий видов деятельности для обеспечения согласованности между субсезонным, сезонным, годовым и десятилетним прогнозированием.

Дополнение 1 к проекту резолюции №№/2 (ИС-78)

*[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]*

2.2.1.x --- Global Climate Reanalysis

2.2.1.x.1 Centres conducting global climate reanalysis (GCR) shall:

- (a) Produce global climate reanalyses at the surface, near-surface and throughout the atmosphere;
- (b) Make digital products available within no more than 60 days behind real time; Update all reanalysis products listed in Appendix A to include the previous month within 60 days of the end of the current month;

- (c) Ensure all products cover at least the most recent WMO climatological reference period;
- (d) Make available on their website digital mandatory products (considered as core data) listed in Appendix A;
- (e) Make available on their website up to date information on the characteristics of their global climate reanalysis systems. The minimum information to be provided is given in Appendix B.

2.2.1.x.2 In addition to the mandatory functions above, GCR should:

- (a) Make available on their website the graphic and digital recommended products listed in Appendix A;
- (b) Produce their digital mandatory and recommended products in one of the following formats: GRIB1, GRIB2, NetCDF or HDF.

Notes:

1. The requirement for the users to be registered and/or accept terms and conditions before retrieving the data does not affect the open and free status of the data.
2. For the purpose of this document climate reanalysis is defined as the output of a prediction model which makes use of observational data to reconstruct past weather and climate in a way that strives to maximize temporal consistency.
3. The bodies in charge of managing the information contained in the present Manual related to global climate reanalysis are specified in the table below.

Table X. WMO bodies responsible for managing information related to global climate reanalysis

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
<u>To be proposed by:</u>	<u>INFCOM/SC-ESMP</u>	<u>INFCOM/ET-OCPS</u>	
<u>To be recommended by:</u>	<u>INFCOM</u>		
<u>To be decided by:</u>	<u>EC/Congress</u>		
<i>Centres designation</i>			
<u>To be recommended by:</u>	<u>INFCOM</u>	<u>RA</u>	
<u>To be decided by:</u>	<u>EC/Congress</u>		
<i>Compliance</i>			
<u>To be monitored by:</u>	<u>INFCOM/ET-OCPS</u>		
<u>To be reported to:</u>	<u>INFCOM/SC-ESMP</u>	<u>INFCOM</u>	

APPENDIX A. MANDATORY AND RECOMMENDED GCR PRODUCTS

1. ----- Mandatory products (as core data) – digital data

<i>Variable</i>	<i>Level</i>
<u>Total precipitation</u>	<u>Surface</u>
<u>Pressure</u>	<u>Surface</u>
<u>Mean sea level pressure (MSLP)</u>	<u>Surface</u>
<u>Sea surface temperature (SST)</u>	<u>Surface</u>
<u>Land mask</u>	<u>Surface (constant)</u>

Topography	Surface (constant)
Sea-ice cover	Surface
Water Equivalent of Snow Cover (Snow Water Equivalent)	Surface
Incoming short-wave radiation	Surface
Outgoing longwave radiation	Top of Atmosphere (TOA)
Dew point temperature / specific humidity / Relative humidity	2 m
Temperature	2 m
Zonal and meridional wind velocity (u, v)	10 m
Geopotential height	850, 500, 200, 100, 50, 30 and 5 hPa
Temperature	850, 500, 200, 100, 50, 30 and 5 hPa
Zonal and meridional wind velocity (u, v)	850, 500, 200, 100, 50, 30 and 5 hPa
Specific humidity	850, 500, 200, 100, 50, 30 and 5 hPa

Notes:

1. The centres provide one of the following variables: dew point temperature, specific humidity, or relative humidity at 2 m based on their products.
2. The centres provide the above variables with at least 1.25° x 1.25° spatial resolution.
3. The centres provide the above variables at least six hourly temporal resolution.
4. The centres also provide the monthly mean of the above variables.

The centres also provide the following products:

- The monthly climatology, calculated based on the most recent WMO climatological reference period, of the above variables
- Time series of global average monthly mean temperature at 2 m

The centres provide the documentation that explains what data are provided.

2. Recommended products – digital data

The centres provide daily climatology, calculated based on the most recent WMO climatological reference period, of the variables listed in the section 1 keeping the same horizontal resolution.

It is recommended to develop and maintain documentation that includes the calculation methods for generating daily climatology.

3. Recommended products – map

The centres provide the spatial maps of monthly mean and anomalies of variables listed in the section 1.

APPENDIX B. CHARACTERISTICS OF GLOBAL CLIMATE REANALYSIS SYSTEMS

1. System

- System name (version):
- Date of implementation:

2. Configuration

- Earth system components included in the analysis system (e.g., ocean, sea-ice, land, etc.):

- Horizontal resolution of the model, with indication of grid spacing in km (for the different Earth system component included in the model):
- Number of levels in the different Earth system components (for the different Earth system component included in the model):
- Frequency of the outputs:
- Top of the atmospheric model:
- Number of analysis cycle per day:
- Earliest start date:
- Integration time step:
- Length and frequency of the longest forecast:
- Data set latency:
- Additional comments:

3. Analysis system

- Data assimilation method:
- Length of the analysis window:
- Number of ensemble members and their resolution:
- Additional comments:

4. Externally prescribed boundary conditions

Note: Briefly describe boundary conditions (if used) and their source:

- Sea surface temperature (SST):
- Sea-ice:
- Snow:
- Vegetation:
- Land use (and its evolution in time):
- Aerosols:
- Green House Gases:
- Solar forcing:
- Additional comments:

5. Details of model

- Dynamical core (e.g., semi-Lagrangian):
- Grid structure:
- Hydrostatic or non-hydrostatic:
- Radiations parameterization:
- Boundary layer parameterization:
- Convection parameterization:
- Cloud parameterization scheme:
- Land surface parameterization scheme:
- Other relevant details:

6. Further information

- Operational contact point:
- URL of the technical note/ reference paper:
- URL for list of products:

7. Observational data used

- URL with the list of observational data used in the reanalysis:
- DOI of data product if available.

8.-----Other sources for data access, if available

2.2.2.x Coordination of assessment of multiple climate reanalysis

2.2.2.x.1 Centre(s) conducting the assessment of multiple climate reanalyses (Lead Centre(s) for Global Climate Reanalysis) shall:

- (a) Select a group of global climate reanalysis centres to contribute to the Lead Centre(s) for Global Climate Reanalysis (referred to as 'contributing centres,' which also includes the designated GCR) that meet the GCR designation criteria and have been approved by ET-OCPS; and manage changes in the membership of the group, as and when they occur;
- (b) Maintain a list of the contributing centres and the specification of their climate reanalysis systems;
- (c) Collect an agreed set of digital mandatory products listed in Appendix XX from contributing centres;
- (d) Interpolate the collected products onto a common horizontal grid, generate climatology, and make them available for each reanalysis;
- (e) Provide a set of graphical mandatory products listed in Appendix XX;
- (f) Make a set of tools to visualize the products as time series and/or maps on the Lead Centre(s)' website.
- (g) Update all reanalysis products listed in Appendix XX to include the previous month within 90 days for the end of the current month;
- (h) Ensure all products cover at least the most recent WMO climatological reference period.

2.2.2.x.2 In addition to the mandatory functions above, Lead Centre(s) for Global Climate Reanalysis should:

- (a) Make available on the Lead Centre(s)' website(s) the digital recommended products listed in Appendix XX;
- (b) Define and provide common evaluation metrics to compare climate reanalysis outputs, jointly with other contributing centres conducting global climate reanalysis;
- (c) Produce their mandatory and recommended digital products in one of the following formats: GRIB1, GRIB2, NetCDF or HDF.

Notes:

1. The requirement for the users to be registered and/or accept terms and conditions before retrieving the data does not affect the open and free status of the data.
2. The digital products will be available through the Lead Centre(s) if the contributing centres agree.
3. The bodies in charge of managing the information contained in the present Manual related to coordination of assessment of multiple climate reanalysis are specified in the table below.

Table X. WMO bodies responsible for managing information related to coordination of assessment of multiple climate reanalysis

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	INFCOM/ET-OCPS	

To be recommended by:	INFCOM		
To be decided by:	EC/Congress		
<i>Centres designation</i>			
To be recommended by:	INFCOM		
To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	INFCOM/ET-OCPS		
To be reported to:	INFCOM/SC-ESMP	INFCOM	

APPENDIX XX. MANDATORY AND RECOMMENDED LEAD CENTRE CLIMATE REANALYSIS PRODUCTS

1. Digital Products

Mandatory products

<i>Variable</i>	<i>Level</i>
Total precipitation	Surface
Pressure	Surface
Mean sea level pressure (MSLP)	Surface
Sea surface temperature (SST)	Surface
Land mask	Surface (constant)
Topography	Surface (constant)
Sea-ice cover	Surface
Water Equivalent of Snow Cover (Snow Water Equivalent)	Surface
Incoming short-wave radiation	Surface
Outgoing longwave radiation	Top of Atmosphere (TOA)
Dew point temperature / specific humidity / Relative humidity	2_m
Temperature	2_m
Zonal and meridional wind velocity (u, v)	10_m
Geopotential height	850, 500, 200, 100, 50, 30 and 5 hPa
Temperature	850, 500, 200, 100, 50, 30 and 5 hPa
Zonal and meridional wind velocity (u, v)	850, 500, 200, 100, 50, 30 and 5 hPa
Specific humidity	850, 500, 200, 100, 50, 30 and 5 hPa

Note: The Lead Centre(s) provide the monthly mean of the above variables on a common grid with at least 1.25° x 1.25° spatial resolution.

The Lead Centre(s) also provide the following products:

- The monthly climatology, calculated based on the most recent WMO climatological reference period, of the above variables;

The Lead Centre(s) provide the documentation that explains what data are provided.

Recommended products

The Lead Centre(s) provide to daily climatology for 2 m, daily minimum and maximum temperature, and total precipitation, calculated based on the most recent WMO climatological reference period, keeping the same horizontal resolution of mandatory products.

It is recommended to develop and maintain documentation that includes the calculation methods for generating daily climatology.

2. Graphical Products

Mandatory Products

Time series and/or maps of digital products listed in the section 1.

Дополнение 2 к проекту резолюции №№/2 (ИС-78)

*[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]*

2.2.1.5 Global numerical sub-seasonal forecasts

2.2.1.5.1 Centres conducting global numerical SSFs (GPCs for Sub-seasonal Forecasts (GPCs-SSF)) shall:

Note: Functions are defined for the sub-seasonal (10 days–4 weeks) forecasting activity.

- (a) With at least weekly frequency, generate SSF products with global coverage;
- (b) Make available on WIS ~~a range of these products; the list of the graphical~~ mandatory products (considered as core data) ~~and highly recommended products to be made available is given~~ **listed** in Appendix 2.2.41;
- ~~(c) Produce verification statistics according to the standard defined in Appendix 2.2.45, and make them available on a website;~~
- ~~(d)~~ Provide ~~an agreed set of forecast and hindcast variables~~ **digital mandatory products** (as defined in Appendix 2.2.43 **(section 1)**) to the Lead Centre(s) for Subseasonal Forecast Multi-model Ensemble (SSFMME) **no more than two days behind real-time**;
- ~~(d)~~ Make available on a website up to date information on the characteristics of their global numerical SSF systems; the minimum information to be provided is given in Appendix 2.2.42.

Note: The definition of core data is provided in Resolution 1 (Cg-Ext(2021)).

2.2.1.5.2 In addition to the mandatory ~~activities~~ **functions** above, GPCs-SSF should:

- (a) Make available on WIS the ~~highly~~ recommended products listed in Appendix 2.2.41;
- (b) Provide digital recommended products to the Lead Centre(s) for SSFMME, as detailed in Appendix 2.2.43 (section 1).**

Note: The bodies in charge of managing the information contained in the present Manual related to global numerical SSFs are specified in the table below.

Table 6. WMO bodies responsible for managing information related to global numerical SSFs

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	INFCOM/ET-OCPS	
To be recommended by:	INFCOM	SERCOM	
To be decided by:	EC/Congress		
<i>Centres designation</i>			
To be recommended by:	RA	INFCOM	
To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	INFCOM/ET-OCPS		
To be reported to:	INFCOM/SC-ESMP	INFCOM	

APPENDIX 2.2.41. MANDATORY AND ~~HIGHLY~~ RECOMMENDED GLOBAL NUMERICAL SUB-SEASONAL FORECAST PRODUCTS TO BE MADE AVAILABLE ON THE WMO INFORMATION SYSTEM

Mandatory products (maps) ~~of Global Producing Centres for Sub-Seasonal Forecasts (GPCs-SSF)~~

<i>Variable</i>	<i>Coverage</i>	<i>Forecast range or lead time</i>	<i>Temporal resolution</i>	<i>Output type</i>	<i>Issuance frequency</i>
2-m temperature	Global	~~Any forecast range (lead time) between zero and four weeks~~	Averages over periods (one day to four weeks)	(1) Ensemble mean anomaly (2) Probabilities for tercile forecast categories (where applicable)	~~Weekly~~ Minimum once a week
Sea surface temperature (SST)	Global oceans				
~~Total precipitation~~ Daily accumulated total precipitation	Global	Minimum forecast range of four weeks			

~~Note: Probabilities for extremes, for the variables specified under mandatory products, are also highly recommended.~~
Note: SST is a mandatory product only for the centres operating 1-Tier systems.

~~Highly r~~Recommended products (maps) ~~of GPCs-SSF~~

<i>Variable</i>	<i>Coverage</i>	<i>Forecast range or lead time</i>	<i>Temporal resolution</i>	<i>Output type</i>	<i>Issuance frequency</i>
500 hPa height	Global	~~Any forecast range (lead time) between zero and four weeks~~ Minimum forecast range of four weeks.	Averages over periods (one day to four weeks)	(1) Ensemble mean anomaly (2) Probabilities for tercile forecast categories	~~Weekly~~ Minimum once a week
Mean sea level pressure (MSLP)					
850 hPa temperature					

Notes:

1. Probabilities for extremes, for the variables specified under mandatory products, are recommended.

2. ~~Extremes (products are recommended, not mandatory) – the recommended definitions to be used for extremes are below 10th percentile and above 90th percentile.~~
3. ~~Output types – rendered images (for example, forecast maps and diagrams). GPCs-SSF are encouraged to make available digital data on the retrospective forecast (hindcast) and forecast fields underlying the products. Gridded binary-2 (GRIB-2) format should be used for fields posted on FTP sites or disseminated through WIS. GPCs-SSF shall provide daily fields of hindcasts and forecasts, as variables listed in Appendix 2.2.43, to the Lead Centre(s) for SSFMME.~~
4. ~~For all products, anomalies are to be expressed relative to a climatology using at least 15 years of retrospective forecasts. To enable the construction of multi-model products, it is recommended the provision of retrospective forecasts covering the most recent 25–30 years period.~~
5. Information on how category boundaries are defined should be made available.
6. Indications of skill will be provided in accordance with Appendix 2.2.45.

~~Highly recommended~~ ~~ed~~ products (diagrams) ~~of GPCs-SSF~~

Diagrams presenting forecasts of the tropical intraseasonal variability such as the Madden–Julian Oscillation (Wheeler and Hendon, 2004; Gottschalck et al., 2010) are ~~highly~~ recommended.

References

- Gottschalck, J.; Wheeler, M.; Weickmann, K. Et al. A Framework for Assessing Operational Madden–Julian Oscillation Forecasts: A CLIVAR MJO Working Group Project. *Bulletin of the American Meteorological Society* **2010**, 91 (9), 1247–1258. <https://doi.org/10.1175/2010BAMS2816.1>.
- Wheeler, M. C.; Hendon, H. H. An All-Season Real-Time Multivariate MJO Index: Development of an Index for Monitoring and Prediction. *Monthly Weather Review* **2004**, 132 (8), 1917–1932. [https://doi.org/10.1175/1520-0493\(2004\)132<1917:AARMMI>2.0.CO;2](https://doi.org/10.1175/1520-0493(2004)132<1917:AARMMI>2.0.CO;2).

Дополнение 3 к проекту резолюции №№/2 (ИС-78)

[Proposed amendments are highlighted in ~~addition~~ or ~~deletion~~ to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

2.2.2.2 Coordination of multi-model ensembles for sub-seasonal forecasts

Centre(s) coordinating SSF multi-model ensembles (Lead Centre(s) for SSFMME) shall:

- (a) ~~Select a group of modelling centres to contribute to the Lead Centre(s) for SSFMME (referred to as 'contributing centres,' which also includes the designated GPC-SSF)) that meet the GPC-SSF designation criteria and have been approved by ET-OCPS; and manage changes in the membership of the group, as and when they occur, to maintain sufficient contributions;~~
- (b) ~~Maintain a list of the active contributing centres and the specification of their prediction systems;~~
- (c) ~~Collect an agreed set of forecast data digital products listed in Appendix 2.2.43 (section 1) from contributing centres GPCs-SSF participating in numerical sub-seasonal forecasting under activity <2.2.1.5> (GPCs-SSF);~~
- (d) ~~Make available on a website of the Lead Centre(s) for SSFMME graphical products listed in appropriate minimum (Appendix 2.2.43) and additional (<Attachment 2.2.5>) products as well as GPC-SSF products in standard format;~~

- (~~ee~~) Redistribute contributing centre digital products forecast data as described listed in Appendix 2.2.~~44~~ 43 for those ~~GPCs-SSF~~ contributing centres that allow it, as described in Appendix 2.2.44;
- (~~fd~~) ~~Maintain an archive of real-time GPCSSF products and multimodel ensemble forecasts~~
Maintain an archive of real-time and hindcast digital product from the contributing centres which is used to construct the LC graphical products listed in 2.2.43;
- (~~ge~~) Maintain a repository of documentation for the system configuration of all ~~GPC-SSF~~ contributing centres systems;
- (~~hf~~) Verify the digital products using the ~~SVSLRF~~ Standardized Verification System for SSF (SVSSSF) in approach ~~{Appendix 2.2.45}~~;
- (~~ig~~) Based on a comparison of different models, provide feedback to ~~GPCs-SSF~~ contributing centres about model performance and make available on ~~at the LC-SSFMME's~~ website the verification results;
- (~~jh~~) Promote research and expertise in multi-model ensemble techniques and provide guidance and support on multi-model ensemble techniques to ~~GPCs-SSF~~ contributing centres, RCCs and NMHSs.

Notes:

1. The website is provided exclusively for the outputs of the specified Lead Centre functions in support of climate services and is to be clearly distinguishable from other types of services.
2. LC-SSFMME will consult contributing centres on which forecast initial conditions to use in the development of real-time products. This will ensure a consistency between contributing centres and LC-SSFMME methodologies.
3. The bodies in charge of managing the information contained in the present Manual related to coordination of multi-model ensembles of SSFs are specified in the table below.

Table 15. WMO bodies responsible for managing information related to multi-model ensemble SSFs

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	INFCOM/ET-OCPS	
To be recommended by:	INFCOM		
To be decided by:	EC/Congress		
<i>Centres designation</i>			
To be recommended by:	INFCOM		
To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	INFCOM/ET-OCPS		
To be reported to:	INFCOM/SC-ESMP	INFCOM	

APPENDIX 2.2.43. MINIMUM INFORMATION TO BE AVAILABLE FROM THE LEAD CENTRE(S) FOR SUB-SEASONAL FORECAST MULTI-MODEL ENSEMBLES

1. ~~Global Producing Centre~~ Digital products

~~Global fields of forecast anomalies as supplied by GPCsSSF, including (for GPCs that allow redistribution of their digital data) weekly Daily mean anomalies global field of forecast variables from contributing centres for ensemble mean individual ensemble members for at least each of the four weeks following the week of submission;~~

~~Global fields of forecast and hindcast as supplied by GPCsSSF, including (for GPCs that allow redistribution of their digital data) dDaily fields from mean global field of forecast variables from contributing centres for individual forecasts ensemble member for at least each of the four weeks following the forecast initialization date;~~

~~(a) Surface (2-m) temperature;~~

~~(b) SST;~~

~~i Total precipitation rate;~~

~~(d) MSLP;~~

~~(e) 850 hPa temperature;~~

~~(f) 500 hPa geopotential height;~~

~~(g) 850 and 200 hPa wind (zonal and meridional);~~

~~(h) Outgoing long wave radiation at the top of the atmosphere;~~

~~(i) 10 hPa zonal wind;~~

~~Note: Definitions of the content and format for the supply of data to the Lead Centre(s) for SSFMME by GPCs and terms of exchange are available on the Lead Centre(s) website(s);~~

Mandatory products

<u>Variable</u>	<u>Level (hPa)</u>	<u>Resolution</u>	<u>Forecast range</u>	<u>Time steps</u>	<u>Frequency</u>
Temperature	2-meter	1.5° × 1.5°	Minimum four weeks from the day of submission	Daily mean	Once a week
Sea surface temperature (SST)	Surface				
Daily accumulated total precipitation	Surface				
Mean sea level pressure (MSLP)	Surface				
Temperature	850				
Geopotential height	500				
Velocity (u, v)	850 and 200				
Velocity (u)	10				
Outgoing long-wave radiation	Top of the atmosphere				

Note: SST is a mandatory product only for the centres operating 1-Tier systems.

Recommended products

<u>Variable</u>	<u>Level (hPa)</u>	<u>Resolution</u>	<u>Forecast range</u>	<u>Time steps</u>	<u>Frequency</u>
Dew point temperature	2-meter	1.5° × 1.5°	Minimum four weeks from the day of submission	Daily mean	Once a week
Minimum temperature	2-meter				
Maximum temperature	2-meter				

<i>Variable</i>	<i>Level (hPa)</i>	<i>Resolution</i>	<i>Forecast range</i>	<i>Time steps</i>	<i>Frequency</i>
Geopotential height	850 and 200				
Specific humidity	850				
Soil moisture	Top 20 cm and 100 cm				

Note: The minimum and maximum temperatures at 2 meters are not daily means; they are selected from a 24-hour window.

2. Graphical products

~~Plots and maps for each GPC forecast displayed in common format on the Lead Centre(s) website(s), for the variables listed in Appendix 2.2.41 and for selectable regions where appropriate;~~

~~for weeks 1, 2, 3-4 and 1-4;~~

~~(a) Ensemble mean anomalies;~~

~~(b) Probabilities for the tercile forecast categories;~~

~~(c) Model consistency plots, that is, maps showing the proportion of models predicting the same sign anomaly;~~

~~(d) Multi-model probabilities for tercile forecast categories;~~

~~for intraseasonal variability;~~

~~(a) Diagrams presenting each GPC forecast of the tropical intraseasonal variability such as the Madden-Julian Oscillation;~~

Mandatory products

Forecast Spatial Maps

	<i>Variable</i>	<i>Forecast Type</i>	<i>Map Type</i>	<i>Digital</i>
Forecast	Daily accumulated total precipitation	DMME; PMME; Individual models	Global and regional maps	No
	500hPa GPH			
	Mean sea level pressure (MSLP)			
	2 m Temperature			
	850hPa Temperature			
	Sea surface temperature (SST)			

Notes:

1. DMME: Deterministic Multi-Model Ensemble.

2. PMME: Probabilistic Multi-Model Ensemble.

3. SST is a mandatory product only for the centres operating 1-Tier systems.

Verification

	<i>Variable</i>	<i>Verification Type</i>	<i>Map Type</i>	<i>Digital</i>
Hindcast	Daily accumulated total precipitation	DMME; PMME; Individual models	Global and regional maps	No
	500hPa GPH			
	Mean sea level pressure (MSLP)			
	2 m Temperature			

	850hPa Temperature			
	Sea surface temperature (SST)			

[Note: Verify products using Standardized Verification System for SSF \(SVSSSF\) \(Appendix 2.2.45\)](#)

[Recommended products](#)

[Forecast Indices](#)

	Parameter	Forecast Type	Map type	Digital
Forecast	Nino1+2	DMME; Individual models	Time series	No
	Nino3			
	Nino4			
	Nino3.4			
	DMI(Indian Ocean Dipole mode index)			
	TSA(Tropical South Atlantic index)			
	TNA(Tropical North Atlantic index)			

[Note: SST indices are recommended products only for the centres operating 1-Tier systems.](#)

[Intraseasonal variability](#)

[Diagrams presenting each contributing centre of the tropical intraseasonal variability such as the Madden-Julian Oscillation are recommended.](#)

[Tropical cyclone](#)

[Graphical maps presenting each contributing centre of the tropical cyclone genesis and activities, including description of the tracking method, are recommended.](#)

APPENDIX 2.2.44. ACCESS TO GLOBAL PRODUCING CENTRE FOR SUB-SEASONAL FORECASTS DATA AND VISUALIZATION PRODUCTS HELD BY THE LEAD CENTRE(S) FOR SUB-SEASONAL FORECAST MULTI-MODEL ENSEMBLES

- Access to [GPC-SSF-contributing centre](#) data from the Lead Centre(s) for SSFMME website(s) will be password protected.
- Digital [GPC-SSF](#) data will be redistributed only in cases where the [GPC-SSF-contributing centre](#) data policy allows it. In other cases, requests for [GPC-SSF-contributing centre](#) digital output should be directed to the relevant [GPC-SSF-contributing centre](#)
- Formally designated GPCs-SSF, GPCs-LRF and RCCs, NMHSs and institutions coordinating RCOFs are eligible for password-protected access to information held and produced by the Lead Centre(s) for SSFMME. Entities that are in demonstration phase to seek designation as GPCs or RCCs are also eligible for password-protected access to information held and produced by the Lead Centre(s) for SSFMME, provided a formal notification has been issued in this regard by the WMO Secretary-General.
- Institutions other than, but providing contributions to, those identified in (c) may also request access to Lead Centre(s) for SSFMME products. These institutions, referred to as "supporting institutions", which include research centres, require endorsement letters from: (i) the Permanent Representative of the country where they are hosted, and (ii) the executive manager of the entity they wish to provide contributions to (that is, RCCs, institutions coordinating RCOFs and NMHSs). The use by supporting institutions of products from the Lead Centre(s) for SSFMME is restricted to assistance of the organizations identified in (c) in their production of official forecast outputs. Supporting

institutions may not use such products to generate and display or disseminate independent forecast products. Supporting institutions must agree with these restrictions to be eligible for access. Prior to access being granted to an applicant supporting institution, the Lead Centre(s) for SSFMME will refer the application to the INFCOM/ET-OCPS through the WMO Secretariat, for final consultation and review. Decisions to allow access must be unanimous. The Lead Centre(s) will be informed by the WMO Secretariat of such new users accepted for access.

- (e) A list of users provided with password access will be maintained by the Lead Centre(s) for SSFMME and reviewed periodically by the INFCOM/ET-OCPS, to measure the degree of effective use and also to identify any changes in status of eligible users, and determine further necessary follow-up.

APPENDIX 2.2.45. STANDARDIZED VERIFICATION SYSTEM FOR SUB-SEASONAL FORECASTS

1. Introduction

This appendix describes procedures for the production ~~and exchange~~ of a standard set of verification scores for SSFs produced by WIPPS centres. ~~Provision of the verification products described here is mandatory for GPCs SSF.~~ The goal is to provide consistent verification information on the SSF products of GPCs that will assist forecasters in RCCs, NMHSs and at RCOFs to prepare regional and national seasonal outlooks, and also to help the GPCs compare and improve their forecast systems. The verification scores described are to be calculated on retrospective forecasts (hindcasts). GPCs will produce and display the verification scores via their websites. Skill measures recommended for use by RCCs in verification of regional forecasts include those described here.

This appendix describes the verification scores and the variables, regions, relevant time averages and lead times for which the scores shall be applied.

2. Verification statistics

The following sections describe the scores that are mandatory for GPCs.

...

~~ATTACHMENT 2.2.5. ADDITIONAL INFORMATION TO BE AVAILABLE FROM THE LEAD CENTRE(S) FOR SUB-SEASONAL FORECAST MULTI-MODEL ENSEMBLE~~

~~The Lead Centre(s) for SSFMME may make available products based on forecast and hindcast data provided by GPCs SSF. These products are additional information to help GPCs, RCCs and NMCs to further develop multi-model ensemble techniques and their application.~~

~~1. Global Producing Centre digital products~~

~~Products should include global forecast fields and corresponding hindcasts for the fields listed in Appendix 2.2.43 and additional variables to be agreed, for those GPCs that allow redistribution.~~

~~2. Graphical products~~

~~Graphical products should include forecast maps for each GPC displayed in common format on the Lead Centre for SSFMME website(s), for the variables listed in Appendix 2.2.43 and for~~

~~selectable regions where appropriate, showing the following for the means for week 1, week 2, weeks 3 and 4, and weeks 1-4:~~

- ~~(a) Tercile category probabilities;~~
- ~~(b) Model consistency plots for most likely tercile category;~~
- ~~(c) Multi-model probabilities for tercile categories;~~

Дополнение 4 к проекту резолюции №№/2 (ИС-78)

*[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]*

2.2.1.6 Global numerical long-range prediction

2.2.1.6.1 Centres conducting global numerical long-range prediction (GPCs for Long-range Forecasts (GPCs-LRF)) shall:

Note: Functions are defined for the seasonal (1–6 month) prediction activity.

- ~~(a) With at least monthly frequency.~~ **Generate** LRF products with global coverage;
- (b) Make available on WIS ~~a range of these products;~~ the list of **graphical** mandatory products (considered as core data) ~~and highly recommended products to be made available is given listed~~ in Appendix 2.2.9;
- ~~(c) Produce verification statistics according to the standard defined in Appendix 2.2.36, and make them available on a website;~~
- ~~(c)~~ **Make** available on a website up-to-date information on the characteristics of their global long-range numerical prediction systems; the minimum information to be provided is given in Appendix 2.2.10;
- ~~(d)~~ **Agree to** Provide **digital mandatory products forecast output** to the Lead Centre(s) for LRF multi-model ensembles (Lead Centre(s) for LRFMME), as detailed in Appendix 2.2.17 (section 1).

Note: The definition of core data is provided in Resolution 1 (Cg-Ext(2021)).

2.2.1.6.2 In addition to the mandatory activities above, GPCs-LRF should:

- (a) Make available on WIS the **highly** recommended products listed in Appendix 2.2.9;
- ~~(b) Make available, on request by Regional Climate Centres (RCCs) or NMCs, the additional data, products and services listed in Attachment 2.2.1, noting that these products and services may be subject to conditions attached by GPCs-LRF;~~
- (b) Provide digital recommended products to the Lead Centre(s) for LRFMME, as detailed in Appendix 2.2.17 (section 1).**

Notes:

1. A candidate to be considered for designation as GPC-LRF are required to produce hindcast verification statistics according to the standard defined in Appendix 2.2.36 and make them available on the candidate's website.

2. It is recommended that the hindcast should cover 1993 – 2016 at the minimum.

3. The bodies in charge of managing the information contained in the present Manual related to global numerical long-range prediction are specified in the table below.

Table 7. WMO bodies responsible for managing information related to global numerical long-range prediction

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	INFCOM/ET-OCPS	
To be recommended by:	INFCOM	SERCOM	
To be decided by:	EC/Congress		
<i>Centres designation</i>			
To be recommended by:	RA	INFCOM	
To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	INFCOM/ET-OCPS		
To be reported to:	INFCOM/SC-ESMP	INFCOM	

APPENDIX 2.2.9. MANDATORY AND ~~HIGHLY~~ RECOMMENDED GLOBAL NUMERICAL LONG-RANGE PREDICTION PRODUCTS TO BE MADE AVAILABLE ON THE WMO INFORMATION SYSTEM

~~Global Producing Centre m~~Mandatory products (maps)

<i>Variable</i>	<i>Coverage</i>	<i>Forecast range or lead time</i>	<i>Temporal resolution</i>	<i>Output type</i>	<i>Issuance frequency</i>
2-m temperature	Global	~~Any forecast range (lead time) between zero and four months~~ Minimum forecast range to four months	Averages over one month or longer periods (seasons)	(1) Ensemble mean anomaly	Monthly
~~Sea surface temperature (SST)~~	Global oceans			(2) Probabilities for tercile forecast categories (where applicable)	
~~Total precipitation~~ Monthly accumulated total precipitation	Global				

~~Probabilities for extremes are not mandatory but are highly recommended.~~

Note: SST is a mandatory product only for the centres operating 1-Tier systems.

~~Global Producing Centre highly r~~Recommended products (maps)

<i>Variable</i>	<i>Coverage</i>	<i>Forecast range or lead time</i>	<i>Temporal resolution</i>	<i>Output type</i>	<i>Issuance frequency</i>
500 hPa height	Global	~~Any forecast range (lead time) between zero and four months~~ Minimum forecast range to four months	Averages over one month or longer periods (seasons)	(1) Ensemble mean anomaly	Monthly
~~Mean sea level pressure (MSLP)~~				(2) Probabilities for tercile forecast categories	
850 hPa temperature					

Note: Provision of probabilities for extremes, for the variables specified under mandatory products, are recommended.

~~Global Producing Centre highly recommended products (SST indices)~~

<i>Index</i>	<i>Description</i>	<i>Coordinates</i>
Pacific Ocean		
Niño 1+2	Region off coasts of Peru and Chile	90°W–80°W, 10°S–0°
Niño 3	Eastern/central tropical Pacific	150°W–90°W, 5°S–5°N
Niño 3.4	Central tropical Pacific	170°W–120°W, 5°S–5°N
Niño 4	Western/central tropical Pacific	160°E–150°W, 5°S–5°N
Atlantic Ocean		
TNA	Tropical North Atlantic	55°W–15°W, 5°N–25°N
TSA	Tropical South Atlantic	30°W–10°E, 20°S–0°
TAD	Tropical Atlantic Dipole	TNA-TSA
Indian Ocean		
WTIO	Western tropical Indian Ocean	50°E–70°E, 10°S–10°N
SETIO	South-eastern tropical Indian Ocean	90°E–110°E, 10°S–0°
IOD (DMI)	Indian Ocean Dipole (Dipole Mode Index)	WTIO–SETIO

Notes:

- Extremes (products are ~~highly~~ recommended, not mandatory) – the recommended definitions to be used for extremes are below 20th percentile and above 80th percentile.
- Output types – rendered images (for example, forecast maps and diagrams). Note: GPCs-LRF are encouraged to make available the retrospective forecast (hindcast) and forecast fields underlying the products. Gridded binary-2 (GRIB-2) format should be used for fields posted on FTP sites or disseminated through WIS. ~~GPCs-LRF are also encouraged to provide hindcast and forecast fields, as listed in Attachment 2.2.4 section 1, to the Lead Centre(s) for LRFMME.~~
- Definition of lead time – for example, a three-monthly forecast issued on 31 December has a lead time of zero months for a January to March seasonal mean forecast, and a lead time of one month for a February to April seasonal mean forecast.
- For all products, forecasts are to be expressed relative to a climatology using at least 15 years of retrospective forecasts.
- Information on how category boundaries are defined should be made available.
- Indices are to be displayed using “plumes” of individual ensemble members and/or the “climagram” approach.
- Indications of skill will be provided in accordance with [Appendix 2.2.37](#).
- ~~SST indices are recommended products only for the centres operating 1-Tier systems.~~

~~ATTACHMENT 2.2.1. ADDITIONAL GLOBAL NUMERICAL LONG-RANGE PREDICTION PRODUCTS TO BE MADE AVAILABLE ON THE WMO INFORMATION SYSTEM~~

~~Other long-range seasonal forecast data, products or other information, in addition to the minimum list in Appendix 2.2.9, which could also be provided by GPCs-LRF on request by RCCs or NMCs (the RCCs and NMCs would adhere to conditions, if any, attached by the GPCs-LRF to these data and products):~~

~~1. Grid point data values:~~

- ~~_____ Hindcast and forecast data for downscaling algorithms;~~
- ~~_____ Data for regional climate model boundary and initial conditions;~~
- ~~_____ Predicted global weekly values of SST.~~

~~2. Information to assist in building capacity in areas such as:~~

- ~~_____ Interpretation and use of seasonal forecast products;~~
- ~~_____ Downscaling techniques (both statistical and dynamical);~~
- ~~_____ Verification techniques (to be used for local verification of RCC-generated products);~~
- ~~_____ Development of local user applications for RCC downscaled products;~~
- ~~_____ Use and implementation of regional climate models.~~

Дополнение 5 к проекту резолюции №№/2 (ИС-78)

[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

2.2.2.3 Coordination of multi-model ensemble prediction for long-range forecasts

Centre(s) coordinating LRF multi-model ensembles (Lead Centre(s) for LRFMME) shall:

- (a) Collect an agreed set of **forecast data digital products listed in Appendix 2.2.17 (section 1)** from ~~RSMCs participating in longrange forecast numerical prediction GPC-LRF~~ under activity 2.2.1.6 ~~(GPCs-LRF)~~;
- (b) Make available on a website **of the Lead Centre(s) for LRFMME graphical appropriate minimum (products listed in Appendix 2.2.17) and additional (Attachment 2.2.4) products and GPC-LRF forecasts in standard format**;
- (c) Redistribute ~~GPCs-LRF digital forecast data products as described in Appendix 2.2.17~~ **8 for those GPCs-LRF that allow it**;
- (d) Maintain an archive of the ~~real-time~~ GPCs-LRF **digital products -LRF** and multi-model ensemble ~~forecasts~~ **products used for graphical products listed in Appendix 2.2.17** ~~orecasts~~;
- (e) Maintain a repository of documentation for the system configuration of all GPCs-LRF systems;
- (f) Verify the products using **Standardized Verification System for LRF(SVSLRF)(Appendix 2.2.36)**;
- (g) Based on comparison among different models, provide feedback to GPCs-LRF about model performance and make available on ~~a the LC-LRFMME's~~ website the verification results;
- (h) Promote research and experience in multi-model ensemble techniques and provide guidance and support on multi-model ensemble techniques to GPCs-LRF, RCCs and NMHSs;~~;~~
- (i) **Prepare and** make available ~~on a website~~ **monthly updates of** Global Seasonal Climate Update (GSCU) and maintain its archive ~~on the LC-LRFMME's website~~.

Notes:

1. The requirement for the users to be registered and/or accept terms and conditions before retrieving the data does not affect the open and free status of the data.

2. The GSCU, issued quarterly, summarizes the current status (monitoring) and the expected future behaviour (prediction) of the global seasonal climate focusing on the major general circulation features and large-scale oceanic anomalies around the globe (e.g., El Niño/Southern Oscillation, North Atlantic Oscillation, Indian Ocean Dipole, etc.) and their potential impacts on the worldwide surface temperature and precipitation patterns.

3. ~~2.~~ The bodies in charge of managing the information contained in the present Manual related to coordination of multi-model ensemble prediction for LRFs are specified in the table below.

Table 16. WMO bodies responsible for managing information related to multi-model ensemble prediction for LRFs

Responsibility

<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	INFCOM/ET-OCPS	
To be recommended by:	INFCOM		
To be decided by:	EC/Congress		
<i>Centres designation</i>			
To be recommended by:	INFCOM		
To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	INFCOM/ET-OCPS		
To be reported to:	INFCOM/SC-ESMP	INFCOM	

APPENDIX 2.2.17. MINIMUM INFORMATION TO BE COLLECTED BY AND AVAILABLE FROM THE LEAD CENTRE(S) FOR LONG-RANGE FORECAST SEASONAL PREDICTION MULTI-MODEL ENSEMBLES

1. ~~Global Producing Centre d~~ Digital products

~~Global fields of forecast anomalies as supplied by GPCs-LRF, including (for GPCs that allow redistribution of their digital data) Collect~~ monthly mean ~~anomalies~~ global fields of forecast variables from GPCs-LRF for individual ensemble members ~~and ensemble mean~~ for at least each of the three months following the month of submission, for example, March, April, May if the month of submission is February:

- ~~(a) Surface (2-m) temperature;~~
- ~~(b) SST;~~
- ~~(c) Total precipitation rate;~~
- ~~(d) MSLP;~~
- ~~(e) 850 hPa temperature;~~
- ~~(f) 500 hPa geopotential height;~~
- ~~(g) 850 hPa zonal and meridional velocity;~~
- ~~(h) Sea ice extent;~~

~~Note: --- Definitions of the content and format for the supply of data to the Lead Centre(s) by GPCs-LRF and terms of exchange are available on the Lead Centre(s) for LRFMME website(s);~~

~~GPCs-LRF not currently able to participate in this additional exchange of data are encouraged to do so in the future;~~

~~Mandatory products to be collected by the Lead Centres for seasonal prediction multi-model ensemble~~

Mandatory products

<i>Variable</i>	<i>Level (hPa)</i>	<i>Resolution</i>	<i>Forecast range</i>	<i>Time steps</i>	<i>Frequency</i>
Surface temperature	2-meter	2.5° x 2.5°	Minimum three months from the month of submissions	Monthly mean	Once a month
Sea surface temperature (SST)	Surface				
Monthly accumulated total precipitation	Surface				
Mean sea level pressure (MSLP)	Surface				
Temperature	850				
Geopotential	500				

<i>Variable</i>	<i>Level (hPa)</i>	<i>Resolution</i>	<i>Forecast range</i>	<i>Time steps</i>	<i>Frequency</i>
<u>height</u>					
<u>Velocity (u,v)</u>	850				

Note: SST is a mandatory product only for the centres operating 1-Tier systems.

Recommended products

<i>Variable</i>	<i>Level (hPa)</i>	<i>Resolution</i>	<i>Forecast range</i>	<i>Time steps</i>	<i>Frequency</i>
<u>Sea-ice concentration</u>	Surface	2.5°×2.5°	Minimum three months from the month of submissions	Monthly mean	Once a month
<u>Snow Water Equivalent (SWE)</u>	Surface				
<u>Velocity (u,v)</u>	10-meter				
<u>Velocity (u,v)</u>	200 hPa				

2. Graphical **mandatory** products

~~Plots and maps for each GPC LRF forecast displayed in common format on the Lead Centre(s) website(s), for the variables listed in the previous section and for selectable regions, where appropriate, showing for three-month means or accumulations:~~

~~(a) Ensemble "plumes" of Niño indices (one-month means);~~

~~(b) Ensemble mean anomalies;~~

~~(c) Probabilities of above/below median;~~

~~(d) Model consistency plots, that is, maps showing the proportion of models predicting the same sign anomaly;~~

~~(e) Multi-model probabilities of above/below median;~~

Forecast Spatial Maps

	<i>Variable</i>	<i>Forecast Type</i>	<i>Map Type</i>	<i>Digital</i>
Forecast	<u>Monthly accumulated total precipitation</u>	DMME; PMME; Individual GPCs Consistency maps	Global and regional maps; Various projections	Yes (Only Global)
	<u>500hPa GPH</u>			
	<u>Mean sea level pressure (MSLP)</u>			
	<u>2 m Temperature</u>			
	<u>850hPa Temperature</u>			
	<u>Sea surface temperature (SST)</u>			
	<u>850hPa Zonal wind</u>			
	<u>850hPa Meridional Wind</u>			

Note: The digital mandatory products required for generating the "individual GPCs' consistency map" are not provided.

Forecast Indices

	<i>Parameter</i>	<i>Forecast Type</i>	<i>Map type</i>	<i>Digital</i>
Forecast	<u>Nino1+2</u>	DMME; Individual GPCs	Time series	No
	<u>Nino3</u>			
	<u>Nino4</u>			
	<u>Nino3.4</u>			
	<u>DMI(Indian Ocean Dipole mode index)</u>			
	<u>TSA(Tropical South Atlantic index)</u>			
	<u>TNA(Tropical North Atlantic index)</u>			

Verifications

	<i>Variable</i>	<i>Verification Type</i>	<i>Map Type</i>	<i>Digital</i>
Hindcast	Monthly _____ accumulated total precipitation	Deterministic; Probabilistic; Individual GPCs	Global and regional maps	Yes (Only Global)
	500hPa GPH			
	Mean sea level pressure (MSLP)			
	2 m Temperature			
	850hPa Temperature			
	Sea surface temperature (SST)			
	850hPa Zonal wind			
	850hPa Meridional Wind			

Notes:

1. DMME: Deterministic Multi-Model Ensemble.

2. PMME: Probabilistic Multi-Model Ensemble.

3. Verify products using Standardized Verification System for LRF (SVSLRF) (Appendix 2.2.36).

3. ~~Mandatory post-processed and original Global Producing Centre digital products~~

Monthly means of global fields of forecast variables collected from GPCs-LRF for individual ensemble members listed in table of mandatory variables in the section 1 of this Appendix.

~~APPENDIX 2.2.18. ACCESS TO GLOBAL PRODUCING CENTRE DATA AND VISUALIZATION PRODUCTS HELD BY THE LEAD CENTRE(S) FOR LONG-RANGE FORECAST MULTI-MODEL ENSEMBLES~~

~~(a) Access to GPC data from the Lead Centre(s) for LRFMME website(s) will be password protected.~~

~~(b) Digital GPC data will be redistributed only in cases where the GPC-LRF data policy allows it. In other cases, requests for GPC-LRF output should be referred to the relevant GPC-LRF.~~

~~(c) Formally designated GPCs-LRF and RCCs, NMHSs and institutions coordinating RCOFs are eligible for password-protected access to information held and produced by the Lead Centre(s) for LRFMME. Entities that are in demonstration phase to seek designation as GPCs-LRF or RCCs are also eligible for password-protected access to information held and produced by the Lead Centre(s) for LRFMME, provided a formal notification has been issued in this regard by the WMO Secretary-General.~~

~~(d) Institutions other than, but providing contributions to, those identified in (c) may also request access to Lead Centre(s) for LRFMME products. These institutions, referred to as "supporting institutions", which include research centres, require endorsement letters from: (i) the Permanent Representative of the country where they are hosted, and (ii) the executive manager of the entity they wish to provide contributions to (that is, RCCs, institutions coordinating RCOFs and NMHSs). The use by supporting institutions of products from the Lead Centre(s) for LRFMME is restricted to assistance of the organizations identified in (c) in their production of official forecast outputs. Supporting institutions may not use such products to generate and display or disseminate independent forecast products. Supporting institutions must agree with these restrictions to be eligible for access. Prior to access being granted to an applicant supporting institution, the Lead Centre(s) for LRFMME will refer the application to the INFCOM/ET-OCPS through the WMO Secretariat, for final consultation and review. Decisions to allow access must be unanimous. The Lead Centre(s) will be informed by the WMO Secretariat of such new users accepted for access.~~

~~(c) A list of users provided with password access will be maintained by the Lead Centre(s) for LRFMME and reviewed periodically by the INFCOM/ET OCPS, to measure the degree of effective use and also to identify any changes in status of eligible users, and determine further necessary follow up.~~

APPENDIX 2.2.36. STANDARDIZED VERIFICATION SYSTEM FOR LONG-RANGE FORECASTS SEASONAL PREDICTION

1. Introduction

This appendix describes procedures for the production ~~and exchange~~ of a standard set of verification scores for LRFs produced by WIPPS centres. ~~Provision of the verification products described is mandatory for GPCs LRF.~~ The goal is to provide consistent verification information on the LRF products of GPCs that will assist forecasters in RCCs, NMHSs and at RCOFs to prepare regional and national seasonal outlooks, and also to help the GPCs compare and improve their forecast systems. The verification scores described are to be calculated on retrospective forecasts (hindcasts). Skill measures recommended for use by RCCs in verification of regional forecasts include those described here.

This appendix describes the verification scores and the variables, regions, seasons and lead times for which the scores shall be applied. The mathematical formulation of the scores is documented on the Lead Centre(s) for LRFMME website(s), together with supplementary information on score calculation, the observational datasets to be used for verification ~~and procedures for submitting scores.~~

...

~~ATTACHMENT 2.2.4. ADDITIONAL INFORMATION TO BE AVAILABLE FROM THE LEAD CENTRE(S) FOR LONG-RANGE FORECAST MULTI-MODEL ENSEMBLES~~

~~As part of research and development, the Lead Centre(s) for LRFMME may make available products based on forecast and hindcast data from the subset of GPCs LRF that are able to supply them. These products are additional information to help GPCs LRF, RCCs and NMCs to further develop multi-model ensemble techniques and their application.~~

~~GPCs LRF not currently able to participate in this additional exchange of data are encouraged to do so in the future.~~

~~1. Global Producing Centre digital products~~

~~Products should include global forecast fields and corresponding hindcasts for the fields listed in Appendix 2.2.17, and additional variables to be agreed, for those GPCs LRF that allow redistribution.~~

~~2. Graphical products~~

~~Graphical products should include forecast maps for each GPC LRF displayed in common format on the Lead Centre(s) website(s), for the variables listed in Appendix 2.2.17 and for selectable regions where appropriate, showing for three month means or accumulations:~~

~~(a) Tercile category probabilities;~~

~~(b) Model consistency plots for most likely tercile category;~~

~~(c) Multi-model probabilities for probabilities for tercile categories, using various established and experimental multi-modelling methods.~~

~~These additional products will be distinguished from Lead Centre core products listed in Appendix 2.2.17.~~

Дополнение 6 к проекту резолюции №№/2 (ИС-78)

*[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]*

2.2.2.4 Coordination of annual to decadal climate prediction

2.2.2.4.1 The centre(s) conducting coordination of ADCP (Lead Centre(s) for ADCP) shall:

- (a) Select a group of modelling centres to contribute to the Lead Centre(s) for ADCP (the "contributing centres") that meet the GPC-ADCP designation criteria and have been approved by ET-OCPS; and manage changes in the membership of the group, as and when they occur, to maintain sufficient contributions;
- (b) Maintain a list of the active contributing centres and the specification of their prediction systems;
- (c) Collect an agreed set of hindcast, forecast and verification data (Appendices 2.2.20 and 2.2.21) from the contributing centres;
- (d) Make available agreed forecast products in standard format, including multi-model ensemble products (Appendix 2.2.20);
- (e) Make available on the website agreed hindcast verification products in standard format, including verification of the multi-model ensemble products (Appendix 2.2.21);
- (f) Redistribute digital hindcast and forecast data for those contributing centres that allow it;
- (g) Maintain an archive of the real-time forecasts from individual contributing centres and from the multi-model ensemble system;
- (h) Promote research and experience in ADCP techniques and provide guidance and support on ADCP to RCCs and NMHSs;
- (i) Based on comparison among different models, provide feedback to the contributing centres on model performance;
- ~~(j) Make available on a website the Global Annual to Decadal Climate Update (GADCU) and maintain its archive;~~
- ~~(k)~~ Coordinate, in liaison with relevant World Climate Research Programme activities, an annual consensus prediction product giving global prospects for the next 1–5 years.

2.2.2.4.2 Access to data and visualization products held by a Lead Centre for ADCP should follow the rules as detailed in Appendix 2.2.19.

Notes:

~~1. The GADCU, issued annually in May, summarizes the predicted future of the global climate over the next year and the next five years. The focus is on climate indices such as global mean near-surface temperature, Atlantic multidecadal variability and the El Niño/Southern Oscillation, as well as regional indices and annual and multi-year seasonal means of near-surface temperature, mean sea level pressure and precipitation. Maps of prediction skill are available to help with interpretation. A short summary of the observed global climate over the past five years is also included, to provide the current climate context.~~

2. The bodies in charge of managing the information contained in the present Manual related to coordination of ADCP are specified in the table below.

Table 17. WMO bodies responsible for managing information related to coordination of ADCP

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	INFCOM/ET-OCPS	
To be recommended by:	INFCOM		
To be decided by:	EC/Congress		
<i>Centres designation</i>			
To be recommended by:	INFCOM		
To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	INFCOM/ET-OCPS		
To be reported to:	INFCOM/SC-ESMP	INFCOM	

Дополнение 7 к проекту резолюции №№/2 (ИС-78)

[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

PART III. CURRENT DESIGNATED WMO INTEGRATED PROCESSING AND PREDICTION SYSTEM CENTRES

3. The Regional Specialized Meteorological Centres for general-purpose activities are:

Global numerical sub-seasonal forecasts:

GPC Beijing
 GPC CPTEC (Brazil)
 GPC ECMWF
 GPC Moscow
 GPC Tokyo

Global climate reanalysis

GCR ECMWF
 GCR NASA (USA)

Acronyms not previously defined: NASA – National Aeronautics and Space Administration

4. The Regional Specialized Meteorological Centres for specialized activities are:

Regional climate prediction and monitoring:

RCC Africa hosted by the African Centre of Meteorological Applications for Development (RA I)

RCC Beijing (RA II)

RCC Caribbean hosted by the Caribbean Institute for Meteorology and Hydrology (RA IV)

RCC Intergovernmental Authority on Development (IGAD) hosted by the IGAD Climate Prediction and Applications Centre (RA I)

RCC Moscow (RA II)

Arctic RCC Network (RA II, IV and VI): Nordic Node with pan-Arctic Climate Data function, Northern Eurasian Node with pan-Arctic Climate Monitoring function, Northern American Node with pan-Arctic Long-Range Forecast function

RCC Network (RA VI): De Bilt node on climate data services, Offenbach node on climate monitoring, and Toulouse and Moscow node on long-range forecasting

RCC Network Northern Africa (RA I)

RCC Network Southern South America (RA III)

RCC Pune (RA II)

RCC Tokyo (RA II)

RCC Washington (RA IV)

RCC Western South America hosted by the International Research Centre on El Niño (RA III)

Notes:

1. RCC Moscow (RA II) – North Eurasian Climate Centre.
2. The RA VI RCC network consists of three nodes: (a) climate data services, led by the Koninklijk Nederlands Meteorologisch Instituut (KNMI), Netherlands; (b) climate monitoring, led by Deutscher Wetterdienst (DWD), Germany; (c) long-range forecasting, jointly led by Météo-France and Roshydromet, Russian Federation. These Lead Centres are fully responsible for discharging the mandatory functions of the RA VI RCC network, with the support of the following contributing NMHSs:
 - RA VI RCC node on climate data services: KNMI (lead), Météo-France, Országos Meteorológiai Szolgálat/Hungary, Meteorologisk Institut (met.no)/Norway, Republic Hydrometeorological Service (RHMS)/Serbia, Swedish Meteorological and Hydrological Institute/Sweden and the Turkish State Meteorological Service (TSMS)/Turkey;
 - RA VI RCC node on climate monitoring: DWD (lead), Armstatehydromet/Armenia, Météo-France, KNMI, RHMS and TSMS;
 - RA VI RCC node on long-range forecasting: Météo-France and Roshydromet (joint leads), met.no, RHMS and TSMS;
 - Overall coordination: DWD is responsible for the overall coordination.
3. The Arctic RCC Network (ArcRCC-Network) comprises three nodes, each performing mandatory functions and relevant recommended functions for a well-defined subregional domain. Additionally, each node consolidates a specific cross-node mandatory function for the entire Arctic region. The structure for ArcRCC-Network is as follows:
 - North American Node, responsible for pan-Arctic Long-Range Forecasting function: Environment and Climate Change Canada (Lead); National Oceanic and Atmospheric Administration/USA (consortium member)
 - Nordic Node, responsible for pan-Arctic Climate Data Services function: Norwegian Meteorological Institute/Norway (Lead); Danish Meteorological Institute/Denmark, Finnish Meteorological Institute/Finland, Icelandic Meteorological Office/Iceland, Swedish Meteorological and Hydrological Institute/Sweden – consortium members
 - Northern Eurasia Node, responsible for pan-Arctic Climate Monitoring function: Russian Service for Hydrometeorology and Environmental Monitoring (Roshydromet)/Russian Federation (Lead)
 - Training function – a common responsibility for all the Nodes
 - Overall coordination by Norwegian Meteorological Institute

Coordination of assessment of multiple climate reanalysis:

Дополнение 8 к проекту резолюции №№/2 (ИС-78)

*[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]*

1.1.2 Activities supported by the WMO Integrated Processing and Prediction System

1.1.2.1 Through WIPPS, Members shall provide and have access to meteorological, hydrological, oceanographic and climatological information supporting a range of operational activities.

1.1.2.2 WIPPS shall be organized as a three-tier system of activities as follows:

Note: A distinction is made between general-purpose and specialized activities: general-purpose activities are those that encompass essential data-processing required for a wide range of end use, while specialized activities are those that make forecasting products, which may include guidance based on human interpretation, tailored for a specific type of application or user community. In addition to these activities conducted in real time, non-real-time operational coordination activities are also part of WIPPS. Associated commitments and other appropriate details are specified in Part II.

(a) General-purpose activities:

- Global deterministic NWP
- Limited-area deterministic NWP
- Global ensemble NWP
- Limited-area ensemble NWP
- Global numerical sub-seasonal forecasts (SSFs)
- Global numerical long-range prediction
- Annual to decadal climate prediction
- ~~Global climate reanalysis~~
- Numerical ocean wave prediction
- Global numerical ocean prediction
- Nowcasting
- Sub-seasonal to seasonal hydrological prediction
- Snow cover prediction

(b) Specialized activities:

- Regional climate prediction and monitoring
- Coordination of multi-model ensembles for sub-seasonal forecasts
- Coordination of multi-model ensemble prediction for long-range forecasts (LRFs)
- Coordination of annual to decadal climate prediction
- ~~Coordination of assessment of multiple climate reanalysis~~
- Regional severe weather forecasting
- Tropical cyclone forecasting, including marine-related hazards
- Nuclear environmental emergency response
- Non-nuclear environmental emergency response
- Atmospheric sand and dust storm forecasts
- Volcano watch services for international air navigation
- Marine meteorological services
- Marine environmental emergency response
- Flash flood forecasting

(c) Non-real-time coordination activities:

- Coordination of deterministic NWP verification (DNV)
- Coordination of Ensemble Prediction System (EPS) verification
- Coordination of wave forecast verification (WV)
- Coordination of tropical cyclone forecast verification (TCFV)
- Coordination of observation monitoring

Note: 1. It is hoped that other activities, including those related to hydrology, agriculture, polar regions, storm-surge prediction, and space weather, will be developed in future.

2. The WIPPS centres responsible for the WIPPS activities such as global numerical sub-seasonal forecasts, global numerical long-range prediction, annual to decadal climate prediction, coordination of multi-model ensembles for sub-seasonal forecasts, coordination of multi-model ensemble prediction for long-range forecasts, coordination of annual to decadal climate prediction, global climate reanalysis and regional climate prediction and monitoring enable the Climate Services Information System (CSIS) through a cascading process from global to regional to national levels. The WMO CSIS is the principal mechanism through which information about climate – past, present and future – is routinely produced, archived, analysed, modelled, exchanged and processed, cascading through global, regional and national levels.

Рекомендация 11 (ИНФКОМ-3)

Поправки к Наставлению по Комплексной системе обработки и прогнозирования ВМО (ВМО-№ 485) для прогнозирования гидрологических параметров и параметров окружающей среды

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолуцию 59 \(КГ-18\)](#) «Поправки к Наставлению по Глобальной системе обработки данных и прогнозирования (ВМО-№ 485)»;
- 2) решение 19 (СЕРКОМ-3) «Предлагаемые поправки к Наставлению по КСОПВ, касающиеся требований к региональным специализированным метеорологическим центрам (РСМЦ), которые осуществляют реагирование на чрезвычайные ситуации на море (РЧСМ)»;
- 3) решение 20 (СЕРКОМ-3) «Предлагаемые поправки к Наставлению по КСОПВ, касающиеся критериев назначения и учреждения РСМЦ для глобального численного прогнозирования штормовых нагонов (ГЧПШН)»,

приняв во внимание состояние исследовательской деятельности ВМО по разработке консультативных систем предупреждений в отношении растительных пожаров и дымового загрязнения, о чем сообщается в документе INFCOM-3/INF. 8.4(1b),

изучив следующий проект поправок к [Наставлению по Комплексной системе обработки и прогнозирования ВМО](#) (ВМО-№ 485):

- 1) обеспечение более высокого временного и пространственного разрешения продукции в области обратного переноса и дисперсии и добавление продукции, связанной с благородными газами, для удовлетворения запроса от Организации по Договору о всеобъемлющем запрещении ядерных испытаний (ОДВЗЯИ) в соответствии с дополнением 1 к проекту резолюции №№/3 (ИС-78);
- 2) изменение способа отправки запрашиваемых форм ОДВЗЯИ и Международным агентством по атомной энергии (МАГАТЭ) в РСМЦ, занимающиеся реагированием на чрезвычайные экологические ситуации ядерного характера, с факсимильной связью

на отправку по электронной почте при сохранении факсимильной связи в качестве альтернативного варианта в соответствии с дополнением 1 к проекту резолюции №№/3 (ИС-78);

- 3) введение глобального механизма для РСМЦ, занимающихся реагированием на чрезвычайные экологические ситуации неядерного характера в Регионах IV и VI, с целью предоставления обслуживания в случае чрезвычайных ситуаций нерадиологического характера Членам за пределами их соответствующих Регионов в соответствии с дополнением 2 к проекту резолюции №№/3 (ИС-78);
- 4) включение региональной ассоциации в качестве ответственного органа при назначении центров, занимающихся реагированием на чрезвычайные экологические ситуации ядерного и неядерного характера, в соответствии с дополнениями 1 и 2 к проекту резолюции №№/3 (ИС-78);
- 5) изменение названия деятельности в рамках Комплексной системы обработки и прогнозирования ВМО (КСОПВ) с «реагирования на чрезвычайные экологические ситуации на море» на «реагирование на чрезвычайные ситуации на море» и обновленных критериев назначения РСМЦ для реагирования на чрезвычайные ситуации на море в соответствии с дополнением 3 к проекту резолюции №№/3 (ИС-78);
- 6) новые критерии назначения РСМЦ для глобального численного прогнозирования штормовых нагонов в качестве деятельности общего назначения в соответствии с дополнением 4 к проекту резолюции №№/3 (ИС-78);
- 7) изменение состава органов ВМО, ответственных за управление информацией, связанной с прогнозами атмосферных песчаных и пыльных бурь, в соответствии с дополнением 5 к проекту резолюции №№/3 (ИС-78);
- 8) новые критерии назначения РСМЦ прогнозирования растительных пожаров и дымового загрязнения в качестве специализированной деятельности в соответствии с дополнением 5 к проекту резолюции №№/3 (ИС-78);
- 9) назначение Канады и Сингапура в качестве РСМЦ прогнозирования растительных пожаров и дымового загрязнения в соответствии с дополнением 6 к проекту резолюции №№/3 (ИС-78);

рекомендует Исполнительному совету принять поправки к [Наставлению по Комплексной системе обработки и прогнозирования ВМО](#) (ВМО-№ 485) для прогнозирования гидрологических параметров и связанных параметров окружающей среды посредством проекта резолюции, представленного в дополнении к настоящей рекомендации.

Дополнение к рекомендации 11 (ИНФКОМ-3)

Проект резолюции №№/3 (ИС-78)

Поправки к *Наставлению по Комплексной системе обработки и прогнозирования ВМО (ВМО-№ 485)* для прогнозирования гидрологических параметров и параметров окружающей среды

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на:

- 1) [резолюцию 59 \(Кг-18\)](#) «Поправки к *Наставлению по Глобальной системе обработки данных и прогнозирования* (ВМО-№ 485)»;

- 2) [резолуцию 30 \(ИС-76\)](#) «Поправки к Наставлению по Глобальной системе обработки данных и прогнозирования (ВМО-№ 485), предложенные Комиссией по наблюдениям, инфраструктуре и информационным системам и Комиссией по обслуживанию и применениям в областях погоды, климата, воды и соответствующих областях окружающей среды»,

отмечая, что Комиссия по наблюдениям, инфраструктуре и информационным системам (ИНФКОМ) разрабатывает регулярный обзор потребностей Комплексной системы обработки и прогнозирования ВМО (РОП КСОПВ) в качестве систематического и прозрачного процесса для поддержки проектирования архитектуры и развития КСОПВ на основе изменяющихся потребностей пользователей, как указано в [решении 19 \(ИНФКОМ-3\)](#),

изучив [рекомендацию 11 \(ИНФКОМ-3\)](#),

согласовав:

- 1) поправки к [Наставлению по Комплексной системе обработки и прогнозирования ВМО](#) (ВМО-№ 485), приведенные в дополнениях с 1 по 5 к настоящей резолюции, за исключением назначения центров, с вступлением в силу с 1 марта 2025 года;
- 2) поправки к [Наставлению по Комплексной системе обработки и прогнозирования ВМО](#) (ВМО-№ 485), касающиеся назначения центров КСОПВ, как указано в дополнении 6, с вступлением в силу с 1 сентября 2024 года,

предлагает Членам провести учения с региональными специализированными метеорологическими центрами (РСМЦ) по реагированию на чрезвычайные экологические ситуации неядерного характера в рамках подготовки к реальным чрезвычайным ситуациям, таким как лесные, травяные пожары или горение торфяников, крупные промышленные пожары, а также выбросы химических веществ, в том числе опасных загрязняющих веществ неядерного характера;

поручает Комиссии по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ) постоянно пересматривать требуемые функциональные возможности и продукцию в области прогнозирования растительных пожаров и дымового загрязнения с использованием РОП КСОПВ;

уполномочивает Генерального секретаря в консультации с президентом ИНФКОМ внести редакционные поправки в [Наставление по Комплексной системе обработки и прогнозирования ВМО](#) (ВМО-№ 485).

Более подробную информацию см. в документе INFCOM-3/INF. 8.4(1b).

Дополнение 1 к проекту резолюции ##/3 (ИС-78)

*[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]*

2.2.2.7 Nuclear environmental emergency response

Centres conducting nuclear environmental emergency response shall:

- (a) Contribute to support for WMO Members and the International Atomic Energy Agency (IAEA):**

- (i) Prepare, on request from a delegated authority¹⁵¹ and/or IAEA, basic information relating to events in which nuclear contaminants have been released into the atmosphere; the activation of the support for nuclear emergency response is described in Appendix 2.2.22;
- (ii) ~~As soon as possible but no longer than~~ ~~Within two to~~ three hours of reception of a request, make a range of products available to the NMHS operational contact point¹⁵² and/or IAEA ~~on WIS~~.¹⁵³ The minimum list, including parameters, forecast range, time steps and frequency, is given in Appendix 2.2.23;
- (iii) Use agreed standard emission source parameters for atmospheric transport and dispersion modelling (ATDM) when source information is not available; default source parameters are given in Appendix 2.2.24;
- (iv) Make available up-to-date information on the characteristics of their ATDM systems (minimum information to be provided is given in Appendix 2.2.25) and a user interpretation guide for ATDM products.

Note: The forms to request WMO support by a delegated authority and by IAEA are given in Appendix 2.2.26.

(b) Contribute to support for the Comprehensive Nuclear-test-ban Treaty Organization (CTBTO):

- (i) Prepare, on request from CTBTO, relevant atmospheric ~~backtracking~~ ~~backward transport and dispersion~~ products;
- (ii) Make the requested products available to CTBTO.

Notes:

1. Arrangements for activation and product specifications are given in Appendix 2.2.27.
2. The bodies in charge of managing the information contained in the Manual related to nuclear environmental emergency response are specified in the table below.

Table 20. WMO bodies responsible for managing information related to nuclear environmental emergency response

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	INFCOM/ET-ERA	
To be recommended by:	INFCOM		
To be decided by:	EC/Congress		
<i>Centres designation</i>			
To be recommended by:	INFCOM	RA	
To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	INFCOM/ET-ERA		
To be reported to:	INFCOM/SC-ESMP	INFCOM	

Acronym not previously defined: ET-ERA – Expert Team on Emergency Response Activities.

APPENDIX 2.2.26. REQUEST FORMS TO ACTIVATE REGIONAL SPECIALIZED METEOROLOGICAL CENTRE SUPPORT (NUCLEAR)

ENVIRONMENTAL EMERGENCY RESPONSE ALERT REQUEST FOR WMO RSMC SUPPORT BY DELEGATED AUTHORITY

This form should be ~~by fax~~ sent to the RSMC ~~by email~~. ~~Fax is an alternative~~. At the same time, the Delegated Authority must immediately call the RSMC to confirm the transmission of this request for RSMC support.

¹⁵¹ The person authorized by the Permanent Representative of the WMO Member to request support.

¹⁵² Designated by the Permanent Representative.

¹⁵³ Via a password-protected dedicated website.

(to be completed by RSMC)

DATE/TIME OF RECEIPT OF REQUEST:.....(UTC)

DATE/TIME OF RETURN CONFIRMATION OF RECEIPT:.....(UTC)

NOTE: All times in UTC.

The IAEA sends the completed form by ~~email fax~~ to all RSMCs and RTH Offenbach. Fax is an alternative. At the same time the IAEA calls the 'Lead' RSMCs (selected on the form) to ensure receipt of this form.

STATUS: ☐ EMERGENCY ☐ EXERCISE		Date/Time of Request: : (UTC)
REQUESTED RSMCS: (indicate the lead RSMCs by a checkmark below)		
☐ EXETER ☐ TOULOUSE ☐ OFFENBACH ☐ VIENNA ☐ MONTREAL ☐ WASHINGTON ☐ BEIJING ☐ TOKYO ☐ OBNINSK ☐ MELBOURNE ☐ RTH Offenbach		
SENDERS NAME: INTERNATIONAL ATOMIC ENERGY AGENCY		
COMMUNICATION DETAILS: Tel.: +43 1 2600 22023 use to confirm receipt of request Fax: +43 1 26007 29309 use to confirm receipt of request Email: iec23@iaea.org use to confirm receipt of request		
NAME OF RELEASE SITE AND COUNTRY (facility and place)		
GEOGRAPHICAL LOCATION OF RELEASE: decimal degrees ☐ N ☐ S (MUST BE COMPLETED) decimal degrees ☐ E ☐ W		

DECLARED EMERGENCY CLASS: ☐ NONE ☐ other, specify:
ACTION REQUIRED: ☐ GO ON STANDBY (request for products or for assistance on weather conditions is to be expected) ☐ LEAD RSMCs ONLY: GENERATE PRODUCTS AND SEND TO IAEA ONLY ☐ ALL RSMCs: GENERATE PRODUCTS AND DISTRIBUTE WITHIN THEIR REGION(S) ☐ OTHER ACTION:

(essential accident information for model simulation – if not available, model will execute with standard default values)
RELEASE CHARACTERISTICS: START OF RELEASE: Date/Time: / : (UTC) DURATION: (hours) or END OF RELEASE: Date/Time: / : (UTC)
RADIONUCLIDE SPECIES: TOTAL RELEASE QUANTITY: (Becquerel) OR POLLUTANT RELEASE RATE: (Becquerel/hour)
EFFECTIVE HEIGHT OF RELEASE: ☐ surface or ☐ release height: base: (m), top: (m)

(helpful information for improved simulation)
SITE ELEVATION: (m)
LOCAL METEOROLOGICAL CONDITIONS NEAR ACCIDENT: (wind speed and direction/weather/cloudiness/precipitation, etc.)
OTHER INFORMATION: (nature of accident, cause, fire explosion, controlled release, foreseeable development, normal activity, projected conditions, etc.)

(to be completed by RSMC)
DATE/TIME OF RECEIPT OF REQUEST:(UTC)
FOR LEAD RSMC(s) ONLY
DATE/TIME OF RETURN CONFIRMATION OF RECEIPT:(UTC)

Note: All times in UTC

APPENDIX 2.2.27. SPECIFICATIONS FOR SUPPORT TO THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION

1. Global arrangements for all Regional Specialized Meteorological Centres to distribute products to the Comprehensive Nuclear-test-ban Treaty Organization

Within the framework of the cooperation agreement between the Preparatory Commission for the CTBTO and WMO that entered into force on 23 May 2003, the Provisional Technical Secretariat (PTS) notifies both the RSMCs designated for the provision of atmospheric **backtracking backward transport and dispersion** products and also the WMO Secretariat in the case that anomalous radionuclide measurements occur in the International Monitoring System. The notification will be in the form of an email message that will specify the coordinates of the

requested stations as well as the start and termination of the measurements. The measurement scenario will not be revealed.

- (a) All notified RSMCs shall acknowledge the receipt of the request and deliver the requested atmospheric ~~backtracking~~ backward transport and dispersion products in electronic form and in the predefined format to a server specified by CTBTO PTS as part of the notification.
- (b) The products shall be delivered as fast as technically possible within defined timelines.
- (c) Every participating RSMC that is temporarily unable to honour the request should notify CTBTO PTS and the WMO Secretariat as soon as possible, but in any case, within 24 hours. The contact officer of the PTS is specified in the email message.
- (d) Requests for support from CTBTO PTS are considered confidential and must not be disclosed.

2. Products provided by Regional Specialized Meteorological Centres with activity specialization in atmospheric transport and dispersion modelling (~~backtracking~~ backward transport and dispersion for Comprehensive Nuclear-test-ban Treaty verification support)

The CTBTO PTS requests support from RSMCs for ATDM (~~backtracking~~ backward transport and dispersion) products by using an email message with the subject line "===== PTS REQUEST FOR SUPPORT =====" to all RSMCs. This will initiate a response from all RSMCs.

The designated RSMCs shall:

- (a) Email back the response form to the responsible officer at PTS within three hours;
- (b) Conduct standardized ~~backtracking~~ backward transport and dispersion computations according to the specifications listed below for all measurements included in the request email message;
- (c) Upload the results on a secured FTP server, as defined in the request email message, within 24 hours of reception and according to the format as defined below.

The specifications for the ~~backtracking~~ backward transport and dispersion are as follows:

- Simulate a release of $1.3 \cdot 10^{15}$ Bq of a tracer integrated backward in time (no deposition, no decay) at a constant rate at the point of the station location from surface to 30 m from measurement stop to measurement start.
- Calculate the respective (backward) tracer concentrations in Bq m³ at a global ~~1° x 1° or~~ 0.5° x 0.5° grid, with an output frequency of ~~three-one~~ three-one hours, time average of output ~~three-one~~ three-one hour, from surface to 30 m.
- Simulate backwards in time to the requested end date/time (up to 30 days from issuance of request).

The PTS shall:

- (a) Restrict requests to cases of anomalous radionuclide measurements or system tests;
- (b) Contact the RSMCs in case no confirmation of a request was received within three hours;
- (c) Conduct regular announced and/or unannounced system tests;
- (d) Share the results of tests with the other RSMCs at a website;
- (e) Send a cancellation message of the request for support to RSMCs when an issued request is cancelled.

The PTS will not request any graphical products or products other than those specified above. Customized end-user products will be produced by the PTS for submission to the national authorities, along with RSMC model output. Measurements and end-user products will not be shared by PTS with RSMCs or WMO Secretariat for reasons of confidentiality.

REQUEST MAIL MESSAGE FOR SUPPORT SENT OUT BY THE PTS TO WMO RSMCs

===== PTS REQUEST FOR SUPPORT =====

Date issued: YYYYMMDD
hhmm Responsible officer:
NAME

Point of contact:

NAME

Tel.

Fax.

name@****.***

Secure website (location/user/password)

Download of information:

****://*****

username

Password

Data upload:

****://*****

Username

Password

For authentication purposes, this mail message is also
available on the website:

****://*****.txt

=====

Source-receptor matrix results are requested for

005

stations

LON LAT ID Measurement Start/stop time YYYYMMDD hh)

001 -70.90 -53.10 CLP18 20050328 15 20050329 15

002 -70.90 -53.10 CLP18 20050329 15 20050330 15

003 -71.25 -41.10 ARP03 20050329 12 20050330 12

004 -58.47 -34.54 ARP01 20050329 18 20050330 18

005 -70.90 -53.10 CLP18 20050330 15 20050331 15

006 -71.25 -41.10 ARX03 20050329 12 20050330 00

=====

Please calculate backward to

YYYYMMDD hh

=====

Please upload data

within 24

hours

==RESPONSE FORM=====

=== WMO Centre response form ===

=== Please send back this form ===

=== to the sender of the request as ===

=== soon as possible ===

=====

(x) We will send our contributions within the time limit (default)

() We will send our contributions kkk hours later then the time limit

() We got your request but are not able to perform computations

=====

===== PTS REQUEST FOR SUPPORT =====

CANCELLATION MAIL MESSAGE SENT OUT BY THE PTS TO WMO RSMCs

===== PTS CANCELS REQUEST FOR SUPPORT =====

Date issued: YYYYMMDD hhmm

FORMAT OF THE MODEL RESULTS AS DELIVERED BY THE RSMCs

Line 1: Header line (station longitude, latitude, start of measurement interval (YYYYMMDD hh), end of measurement interval (YYYYMMDD hh), release strength (Bq), number of hours backward, output every "k" hours, time average of output, horizontal grid space in x direction, horizontal grid space in y direction, station name)

Line 2-k: data lines (latitude, longitude, time step number, value)

17.57 59.23 20030106 09 20030107 09 0.13E+16 144 3 3 1.0 1.0 "SEP63"

58.00 15.00 1 0.1209120E-01

59.00 15.00 1 0.6446140E-01

60.00 15.00 1 0.3212887E-02

58.00 16.00 1 0.2649441E+01

59.00 16.00 1 0.9029172E+01

60.00 16.00 1 0.7616042E-01

58.00 17.00 1 0.1073919E+02

59.00 17.00 1 0.3082339E+02

60.00 17.00 1 0.1408468E-01

58.00 18.00 1 0.2643455E+00

59.00 18.00 1 0.7357535E+00

58.00 14.00 2 0.7759376E-02

59.00 14.00 2 0.6508716E-01

60.00 14.00 2 0.2403110E-01

61.00 14.00 2 0.6662516E-03

62.00 14.00 2 0.2838572E-04

58.00 15.00 2 0.1015775E+01

59.00 15.00 2 0.5030275E+01

60.00 15.00 2 0.8239139E+00

61.00 15.00 2 0.6797127E-02

62.00 15.00 2 0.6521360E-04

58.00 16.00 2 0.8181147E+01

59.00 16.00 2 0.2503959E+02

60.00 16.00 2 0.5937406E+00

61.00 16.00 2 0.1784474E-02

58.00 17.00 2 0.1403705E+02

59.00 17.00 2 0.3715418E+02

60.00 17.00 2 0.1306086E-01

58.00 18.00 2 0.2718492E+00

59.00 18.00 2 0.7555131E+00

.....

Дополнение 2 к проекту резолюции ##/3 (ИС-78)

[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

2.2.2.8 Non-nuclear environmental emergency response

Note: This activity includes a network of regional centres and NMCs within a geographical region.

Centres conducting non-nuclear environmental emergency response shall:

- (a) Prepare, on request from an authorized person,¹⁵⁴ ATDM forecast or hindcast products relating to events in which hazardous non-nuclear contaminants have been released into the atmosphere; the criteria for activation of the regional support procedures and the request form are given in Appendices 2.2.28 and 2.2.32, respectively;
- (b) As soon as possible, but usually within two hours of a request from an authorized person, make available a range of products to the NMHS operational contact point¹⁵⁵ by email or retrieval from the RSMC password-protected designated website; the list of mandatory and **highly** recommended products to be made available, including parameters, forecast range, time steps and frequency, is given in Appendix 2.2.29;
- (c) Use agreed default emission source parameters for essential parameters when actual source information is not available; default source parameters for a range of release scenarios are given in Appendix 2.2.30;
- (d) Make available on a website up-to-date information on the characteristics of their ATDM systems (minimum information to be provided is given in Appendix 2.2.31) and a user interpretation guide for ATDM products.

Note: The bodies in charge of managing the information contained in the present Manual related to non-nuclear environmental emergency response are specified in the table below.

Table 21. WMO bodies responsible for managing information related to non-nuclear environmental emergency response

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	INFCOM/ET-ERA	
To be recommended by:	INFCOM		
To be decided by:	EC/Congress		
<i>Centres designation</i>			
To be recommended by:	INFCOM	RA	
To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	INFCOM/ET-ERA		
To be reported to:	INFCOM/SC-ESMP	INFCOM	

¹⁵⁴ The person authorized by the Permanent Representative of the WMO Member to request RSMC support; normally the NMHS operational contact point.

¹⁵⁵ Designated by the Permanent Representative.

APPENDIX 2.2.28. ACTIVATION OF SUPPORT FOR NON-NUCLEAR ENVIRONMENTAL EMERGENCY RESPONSE

Environmental emergencies can be caused by a broad range of events with various temporal and spatial scales involving the release of hazardous substances into the environment. The scope of non-nuclear emergency response activities includes: smoke from large fires, chemical releases and industrial fire/smoke. Atmospheric sand and dust storm forecasts are covered under activity 2.2.2.9. Ash emitted by volcanic eruptions, in relation to aviation, is covered under activity 2.2.2.10 – Volcano watch services for international air navigation.

National Meteorological and Hydrological Services may request RSMC support for releases that have the potential for long-range impacts (distances greater than 50 km), according to the capability of the RSMC. Products of RSMCs are typically not applicable to shorter-range incidents. Regional Specialized Meteorological Centres may be able to provide services for other types of incident on a case-by-case basis and will advise NMHSs if requests are not within their capabilities.

National Meteorological and Hydrological Services requesting RSMC support shall:

- Request via the authorized person¹⁵⁶ that an RSMC provides, in accordance to its designation, products relating to events in which hazardous non-nuclear contaminants have been released into the atmosphere;
- Send, by email (preferred) or fax, the completed form in Appendix 2.2.32 to the appropriate RSMC; if the RSMC has not confirmed reception within 20 minutes, the requester shall contact the RSMC by phone or email;
- Provide the RSMCs with the essential information specified on the request form;
- Distribute the products within their State or territory based on their national arrangements.

Global arrangements

Until such time as new RSMCs have been designated, it is proposed that RA VI-designated RSMCs be responsible for providing services for non-radiological emergencies to RA I and RA II; RA IV-designated RSMCs be responsible for providing services to RA III, RA V and the Antarctic.

APPENDIX 2.2.30. DEFAULT EMISSION SOURCE PARAMETERS (NON-NUCLEAR)

<i>Scenario*</i>	<i>Type of event</i>	<i>Material released</i>	<i>Rate of emission</i>	<i>Vertical distribution</i>
Forest, grass or peat fires	Smoke	Tracer	One unit mass per hour over 36 hours	Constant from the surface to 500 m
Major industrial fire	Smoke	Tracer	One unit mass per hour over 6 hours	Constant from the surface to 500 m
Chemical release not involving fire	Chemical	Tracer	One unit mass per hour over 6 hours	Constant from the surface to 20 m

¹⁵⁶ The person authorized by the Permanent Representative of the WMO Member to request RSMC support; normally the NMHS operational contact point.

Other events	RSMC defined	Tracer	RSMC defined	RSMC defined

* Default date and start time of release are those given in the request form (mandatory information). If not provided, the date and time of reception of the request will be used.

Дополнение 3 к проекту резолюции ##/3 (ИС-78)

[Proposed amendments are highlighted in addition or ~~deletion~~ to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

2.2.2.12 **Marine ~~environmental~~ emergency response** **Centres conducting Marine Emergency Response (MER) shall:**

- (a) Prepare, on request from an authorized person, MER analysis and forecast products relating to non-nuclear marine pollution (MER-Non-nuclear Pollution) and/or Search and Rescue (MER-SAR) incidents for global or ocean basin (Atlantic, Pacific, Indian, Arctic and Southern¹) [depending on their designation], or part of an ocean basin; the procedures for activation of the regional support and the request form are given in Appendices 2.2.X and 2.2.X+1;**
- (b) As soon as possible, but usually within one hour for a SAR event / four hours for a non-nuclear marine pollution of a request is received from an authorized person, make available a range of products to the requester only in a pre-agreed secured method (e.g. by email, retrieval from the RSMC password protected designated website and/or FTP server); the list of mandatory and recommended products to be made available, including parameters, forecast range, time steps and frequency, is given in Appendix 2.2.XX+2;**
- (c) Use default emission source parameters for a Marine Drifting Modelling (MDM) when actual source information is not available; default emission source parameters for a range of scenarios are given in Appendix 2.2.XX+3;**
- (d) Make available on a website up-to-date information on the characteristics of their MDM systems (minimum information to be provided is given in Appendix 2.2.XX+4), including type of incidents and geographic coverage, and a user interpretation guide for MER products, including a list of oil and/or other hazardous and noxious substances, as well as the classification of objects that could be used in the drift models;**
- (e) Participate in MER testing exercises at the request of WMO or International Maritime Organization (IMO), and their Members/Member States, including national authorities; all products provided in this context shall be labelled as "EXERCISE – EXERCISE – EXERCISE" in all pages and in large font.**

Notes:

- A hazardous and noxious substance in this Manual is defined as any substance, including oil, which, if introduced into the marine environment is likely to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea.
- An authorized person is a 24/7 operational contact point from an NMHS, a Rescue Coordination Centre, and/or a Regional Marine Pollution Emergency Response Centre. This(ese) person(s) is(are) nominated by the General-Director(s) of the NMHS, the Rescue Coordination Centre, and the Regional Marine Pollution Emergency Response Centre; and are authorized by Permanent Representative of the WMO Member hosting these Centres. The WMO Secretariat maintains a list of operational contact points and authorized persons on its website, and regularly informs WMO Members through a circular letter; ~~Operations, including practices, procedures and specifications are described in the Manual on Marine Meteorological Services (WMO-No. 558), Volume I;~~

3. Centres can be designated to conduct MER-SAR or MER-Non-nuclear Pollution or both; Functions and responsibilities to be defined by the SERCOM/SC-MMO during the intersessional period;
4. Centres can be designated to conduct MER-Non-nuclear Pollution for oil and/or other non-nuclear hazardous and noxious substance(s) depending on their capabilities;
5. Designated centres can have a global, an ocean basin (Atlantic, Pacific, Indian, Arctic and Southern Ocean), or part of an ocean basin (e.g. North/South Atlantic/Pacific/Indian Ocean) coverage;
6. Designated RSMC-MER may wish to develop a web interface for registered users to submit the Request Form in case of incident;
- 3.7. The bodies in charge of managing the information contained in the *Manual* related to marine ~~environmental~~ emergency response are specified in the table below.

Table 24. Bodies responsible for managing information related to marine ~~environmental~~ emergency response

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	SERCOM/SC-MMO	
To be recommended by:	SERCOM	INFCOM	
To be decided by:	EC/Congress		
<i>Centres designation</i>			
To be approved by:	SERCOM	INFCOM	
To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	SERCOM/SC-MMO		
To be reported to:	INFCOM	SERCOM	

APPENDIX 2.2.XX PROCEDURES FOR ACTIVATION OF SUPPORT FOR MARINE EMERGENCY RESPONSE

Marine emergencies are a range of scenarios and types of events listed in Appendix 2.2.XX+3. The scope of marine emergency response (MER) activities includes: spills of oil and other non-nuclear hazardous and noxious substances; and SAR.

The MER request for WMO Regional Specialized Meteorological Centre support by an authorized person is activated based on the following procedures:

- (a) The request form shall be sent by email to one of the operational contacts in the RSMC-MER (either MER-SAR or MER-Non-nuclear Pollution) covering the related ocean basin (Atlantic, Pacific, Indian, Arctic and Southern Ocean) or part of it or, in case of non-existence, to an RSMC-MER with global coverage, when marine meteorological and specialized services (as listed in APPEDIX 2.2.XX+2) are required in support of MER;
- (b) Any submission of a request shall be accompanied by a confirmation of receipt of request in a pre-agreed method (e.g. a telephone call);
- (c) In case the requester is a Rescue Coordination Centre or a Regional Marine Pollution Emergency Response Centre, it shall always copy the email with the Request Form to the NMHS(s) of the nearest country(ies) of the incident, who shall also receive the MER products from the RSMC-MER;
- (d) The RSMC-MER (either MER-SAR or MER-Non-nuclear Pollution) shall make available its products as high priority for timely response, preferably within one hour in case of a SAR incident and four hours in case of a release of non-nuclear hazardous and noxious substances. An email shall be sent by the RSMC-MER with information on where to access the products. The requester must acknowledge receipt of the products by email. The requester may also inquire with the RSMC-MER in relation to the interpretation of the products, if required.

Note: Operational contacts in the RSMC-MER are nominated by the Permanent Representative of the WMO Member hosting the designated RSMC-MER.

APPENDIX 2.2.XX+1 REQUEST FORM TO ACTIVATE REGIONAL SPECIALIZED METEOROLOGICAL CENTRE SUPPORT (MER)

EXERCISE – EXERCISE – EXERCISE / REAL INCIDENT [Select as appropriate]

Notes:

1. Please acknowledge receipt of the Request Form.
2. Delay of Response: (a) for SAR incident, MER products shall be provided within 1 hour; (b) for Non-nuclear Pollution, MER products shall be provided within 4 hours.

From (Institution): Name (Focal Point): Tel.(s): Fax.: Email:	To (Institution): Tel.(s): Fax.: Email:

Date and time of Request (DD/MM/YYYY and UTC):

(a) Mandatory information:

Select type of incident and provide brief description or details:

_____ Release of non-nuclear hazardous and noxious substances

_____ Search and Rescue of a floating object (e.g. person, container, etc.).

.....

Note: A list of non-nuclear hazardous and noxious substances, as well as the classification of objects that can be used in the drift models, are provided on the RSMC-MER website.

Date and start time of the incident (DD/MM/YYYY and UTC):

Note: If appropriate, provide the uncertainty of the time of the incident, e.g. a time range.

Location of the release or the deployment of the floating object (as accurately as possible) in order of preference:

i. Geographic coordinates (degrees, minutes and hundredth of minutes):

Latitude (specify N or S)	
Longitude (specify E or W)	

Note: If appropriate, please provide the uncertainty in the initial location (in km/NM)

ii. If appropriate, provide the nearest location in land (e.g. city, country):

Expected or estimated release duration (in case of a release of non-nuclear hazardous and noxious substances) and rate:

Duration of simulation for the drift model run (e.g. 24h, 36h, 48h):

Name or type of pollutant(s) or floating object to be modelled if known (oil, container, human being etc.) – if unknown, a tracer will be used:

Quantity (mass), type of release (continuous or instantaneous) and release rate (mass per unit time) of pollutant if continuous. If unknown, one unit mass or one unit mass per hour will be used:

(b) Other information – If known, the following would be useful for the modelling and should be provided as well (if not provided, modeller will use default parameters or make a reasonable assumption):

Name of object (name of vessel, IMO number, news release etc.):

Meteorological conditions at location at the start of the release or the deployment of the floating object (wind speed and direction, weather, cloudiness, presence of inversion, etc.):

Size of area of interest (for example, within 300 nm of source):

In case of non-nuclear marine pollution, if quantity (mass) and name of pollutant(s) are provided, what concentrations should be displayed on modelling outputs? Please specify:

Any other information that may be useful:

APPENDIX 2.2.XX+2 MANDATORY PRODUCTS

The following mandatory MER products (in graphical format; at intervals of one, three or six hours; up to 24h, 36h or 48h as per the request) shall be provided by the RSMC-MER:

– To support MER-Non-nuclear Pollution operations (default values in Appendix 2.2.XX+3 shall be used for source parameters, if not provided):

- Drift forecasts/model outputs
- Relative concentrations or density of points

----- To support Search and Rescue operations:

- Drift forecasts/model outputs

The RSMC shall perform a quick assessment of the products before they are issued and shall provide a short explanatory message if any issues of concern are noted.

If deemed requested, the RSMC-MER should also provide analysis and forecasts (at intervals of one, three or six hours; up to 24h, 36h or 48h as per the request) of:

- Wind speed and direction (graphical format)
- Sea state, including significant wave height and mean direction (graphical format)
- Visibility (text format)
- Cloud coverage (text format)
- Humidity (text format)
- Ocean currents and temperature (graphical format)
- Sea-ice (only applicable for Polar or seasonal ice Regions) (graphical format)

The following recommended MER products could be provided by the RSMC-MER:

- Tide height and time (observations and forecasts) (text format)

APPENDIX 2.2.XX+3 SCENARIO IN THE SCOPE, TYPES OF THE EVENT AND DEFAULT SOURCE PARAMETERS (MER-SAR AND MER-NON-NUCLEAR POLLUTION)

<i>Scenario*</i>	<i>Type of event</i>	<i>Material released</i>	<i>Vertical distribution</i>
<u>Oil Spill</u>	<u>Oil</u>	<u>Tracer</u>	<u>Surface</u>
<u>Non-nuclear hazardous and noxious substances other than oil</u>	<u>Chemical, algae, etc.</u>	<u>Tracer</u>	<u>Constant from the surface to 200m</u>
<u>Search and Rescue</u>	<u>Human/wrecks, container, etc.</u>	<u>Tracer</u>	<u>Surface</u>
-	-	-	<u>RSMC defined</u>

* Default date and start time of release are those given in the request form (mandatory information) in Appendix 2.2.XX+1. If not provided, the date and time of reception of the request will be used.

APPENDIX 2.2.XX+4 CHARACTERISTICS OF MARINE DRIFTING MODELLING SYSTEMS

1. System

- System Name (version)
- Type of a drift model
- Geographical domain
- Oceanographic model and NWP model used
- Implementation date
- References

2. Initial conditions and trajectory algorithm

- Input (pollutant/object data)
- Input (environmental data)
- Trajectory algorithm: wind
- Trajectory algorithm: current
- Trajectory algorithm: waves (generation method, effect on advection)
- Fate algorithm: evaporation, emulsification
- Any other fate and weathering processes

3. Other details of the model

- Model validation/verification for at least one event

4. Further information

- URLs for system documentation
- URLs for list of trials and actual marine pollution and SAR emergencies

Дополнение 4 к проекту резолюции ##/3 (ИС-78)

[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

2.2.1.X Global numerical storm surge prediction

Centres conducting global numerical storm surge prediction shall:

- (a) Prepare as available global analyses, pseudo analyses or initial condition of variables contributing to ocean total water level;**
- (b) Prepare global forecast fields of basic and derived variables contributing to ocean total water level;**
- (c) Make available on WIS a range of these products; the list of mandatory and recommended products to be made available is given in Appendix 2.2.X;**
- (d) Prepare verification statistics and make them available on a website;**
- (e) Make available on a website up to date information on the characteristics of their global numerical storm surge prediction systems; the minimum information to be provided is given in Appendix 2.2.X+1.**

Note: The bodies in charge of managing the information contained in the Manual related to global numerical storm surge prediction are specified in the table below.

Table X. Bodies responsible for managing information related to global numerical storm surge prediction

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	SERCOM/SC-MMO	
To be recommended by:	INFCOM	SERCOM	
To be decided by:	EC/Congress		
<i>Centres designation</i>			
To be recommended by:	RA	INFCOM	SERCOM

To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	SERCOM/SC-MMO		
To be reported to:	INFCOM	SERCOM	

APPENDIX 2.2.X. MANDATORY AND RECOMMENDED GLOBAL NUMERICAL STORM SURGE PREDICTION PRODUCTS TO BE MADE AVAILABLE ON THE WMO INFORMATION SYSTEM

<i>Parameter</i>	<i>Level</i>	<i>Minimum resolution</i>	<i>Forecast range</i>	<i>Minimum time steps</i>	<i>Frequency</i>
Total Water level	Surface	0.1° x 0.1°	Up to 3 days	Hourly	Twice a day
Tide	Surface				
Storm Surge	Surface				

Recommended products:

Forecast range: Up to 7 days

Ensembles

Vertical reference for these data; e.g. mean sea level, geoid.

APPENDIX 2.2.X+1. CHARACTERISTICS OF THE GLOBAL NUMERICAL STORM SURGE PREDICTION SYSTEMS

1. System

- System name (version):
- Date of implementation:

2. Configuration

- Horizontal resolution of the model, with indication of grid spacing in km:
- Number of model vertical levels:
- Forecast length and forecast step interval:
- Runs per day (times in UTC):
 - Is model barotropic or baroclinic?
- Is model coupled to ocean, wave, atmosphere, sea-ice models? Specify which models:
 - Horizontal and vertical coordinate system of the model:
- Integration time step:
- Additional comments:

3. Initial conditions

- Method used to produce initial conditions and if relevant, any of the following information:
- Data assimilation method
- Climatology data of the model:
 - Observations being assimilated:
 - Assimilated window:
- Additional comments:

4. Surface boundary conditions

- Surface forcing, briefly describe method(s), spatial resolution, frequency, and origin of atmospheric surface forcing:

- Lateral or external forcings (e.g. sea-ice).
- Lateral boundary conditions (for example, sea-ice, river discharge)? If so, briefly describe method(s), frequency, and origin of lateral boundary conditions:
- Additional comments:

5. Other details of model

- How is total water level computed? (e.g. linear superposition)
- What is the vertical reference datum? (mean sea level, geoid).
- Wave model characteristics (such as, but not limited to configuration, initial and boundary conditions):
- Sea-ice model characteristics (such as, but not limited to resolution, rheology, number of sea-ice category):
- Are tide and surge interaction considered?
- Are ice or density effect considered?
- How is the bathymetry obtained?
- Source, resolution, and interpolation method
- Is the water depth clipped and if so at what depth?
- Is wetting and drying considered?
- Verification approach (e.g. following the Guide to Storm Surge Forecasting, or the Surge Model Intercomparison Project, or other)
- Other relevant details?

6. Products delivered

- Numerical model data output in netCDF or GRIB2
- Resolution of the products
- Interpolation method if products are post-processed
- Frequency of the products
- Latency of the products (time between production and availability).

7. Further information

- Operational contact point:
- URLs for system documentation:
- URL for list of products:

Annex 5 to draft Resolution ##/3 (EC-78)

*[Proposed amendments are highlighted in **addition** or **deletion** to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]*

2.2.2.9 Atmospheric sand and dust storm forecasts

Centres conducting atmospheric sand and dust storm forecasts shall:

- (a) Operate an NWP model incorporating parameterizations of all the major phases of the atmospheric dust cycle;**
- (b) Prepare limited-area analyses of variables relevant to atmospheric sand and dust storms;**

- (c) **Prepare limited-area forecast fields of variables relevant to atmospheric sand and dust storms;**
- (d) **Make available on WIS and on a web portal a range of these products; the list of mandatory products to be made available is given in Appendix 2.2.33.**

Note: The bodies in charge of managing the information contained in the present Manual related to atmospheric sand and dust storm forecasts are specified in the table below.

Table 22. WMO bodies responsible for managing information related to atmospheric sand and dust storm forecasts

<i>Responsibility</i>			
<i>Changes to activity specification</i>			
To be proposed by:	INFCOM/SC-ESMP	~~INFCOM/ET-ERA~~	RB/SDS-WAS Steering Committee
To be recommended by:	~~RB (WWRP/SSC)~~ RB/EPAC SSC	INFCOM	
To be decided by:	EC/Congress		
<i>Centres designation*</i>			
To be recommended by:	~~RB (WWRP/SSC, SDS-WAS Steering Group)~~ RB/EPAC SSC	INFCOM	RA
To be decided by:	EC/Congress		
<i>Compliance</i>			
To be monitored by:	~~INFCOM/ET-ERA~~ INFCOM/SC-ESMP		
To be reported to:	INFCOM/SC-ESMP	INFCOM	

Acronyms not previously defined: RB – Research Board; SDS-WAS – Sand and Dust Storm Warning Advisory and Assessment System; ~~WWRP~~EPAC/SSC – ~~WMO World Weather Research Programme~~ Environmental Pollution and Atmospheric Chemistry Scientific Steering Committee.

2.2.2.x Vegetation fire and smoke pollution forecasts

Centres conducting vegetation fire and smoke pollution forecasts shall:

- (a) Operate at least an atmospheric chemistry model incorporating parameterizations of all major processes (emission, transport and deposition) related to fire propagation, and fire smoke dispersion in the atmosphere;**
- (b) Prepare limited-area forecast fields of variables relevant to fire information and atmospheric pollution;**
- (c) Prepare limited-area products on fire activity and fire risk;**
- (d) Make available on a website a range of mandatory and recommended products listed in Appendix A;**
- (e) Make available on a website up to date information on the characteristics of its atmospheric chemistry system.**

Note: The bodies in charge of managing the information contained in the present Manual related to Vegetation fire and smoke pollution forecasts are specified in the table below.

Table. WMO bodies responsible for managing information related to vegetation fire and smoke pollution forecasts

<u>Responsibility</u>			
<u>Changes to activity specification</u>			
<u>To be proposed by:</u>	<u>INFCOM/SC-ESMP</u>	<u>VFSP-WAS Steering Committee</u>	
<u>To be recommended by:</u>	<u>RB/EPAC SSC</u>	<u>INFCOM</u>	
<u>To be decided by</u>	<u>EC/Congress</u>		
<u>Centres designation</u>			
<u>To be recommended by:</u>	<u>RB/EPAC SSC</u>	<u>INFCOM</u>	<u>RA</u>
<u>To be decided by</u>	<u>EC/Congress</u>		
<u>Compliance</u>			
<u>To be monitored by:</u>	<u>INFCOM/SC-ESMP</u>		
<u>To be reported to:</u>	<u>INFCOM/SC-ESMP</u>	<u>INFCOM</u>	

APPENDIX A. MANDATORY AND RECOMMENDED VEGETATION FIRE AND ATMOSPHERIC SMOKE POLLUTION PRODUCTS

1. Mandatory products

Analysis products for the current fire situation:

- Daily fire activity for last two days: daily release of fire energy (J), burnt area (m²), or other gridded variable quantifying the fire intensity for the specific day

Forecast products shall include the following set of variables:

- Surface concentrations of PM_{2.5} and PM₁₀ (kg m⁻³)

Forecasts shall cover the period from the starting forecast time (0000 and/or 1200 UTC) up to a forecast time of at least 72 hours, with an output frequency of at least three hours.

Forecast shall cover the whole designated area. The horizontal resolution of model configuration shall be finer than 0.5° x 0.5°.

Forecasts shall be available on its website not later than 12 hours after the starting forecast time.

An explanatory note should be published on the web portal if operations are interrupted due to technical or organizational problems.

An explanatory note on the methodology used to produce "daily fire activity" shall be available on the web portal.

2. Recommended products

Forecast products, shall include the following set of variables:

- Surface concentrations of relevant gaseous compounds near the surface (kg m⁻³ or mole m⁻³) for at least the following species: CO, CO₂, O₃, SO₂, NO_x and VOC
- Surface concentration by species (kg m⁻³) for PM_{2.5} and PM₁₀ fractions, including at least Organic Matter (OM) and Black Carbon (BC)

- Aerosol optical column depth at 550 nm (unitless)
- Aerosol optical column depth at 550 nm (unitless) by species including at least Organic Matter (OM) and Black Carbon (BC)
- Hourly emission of fire smoke composition: aerosol PM chemical speciation (including at least OM and BC), and major green house (CO₂) and reactive gaseous (CO, O₃, SO₂, NO_x and VOC) species (kg m⁻² h⁻¹ or mole m⁻² h⁻¹)
- Fire risk index: categorical map including at least four categories, i.e., low, moderate, high, and extreme.

Evaluation of the forecasts for surface concentrations and/or total aerosol optical column depth in the range between 340 nm and 1020 nm.

Annex 6 to draft Resolution ##/3 (EC-78)

[Proposed amendments are highlighted in addition or deletion to the Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) and the numbering of the text below refers to the Manual.]

PART III. CURRENT DESIGNATED WMO INTEGRATED PROCESSING AND PREDICTION SYSTEM CENTRES

4. The Regional Specialized Meteorological Centres for specialized activities are:

...

Vegetation fire and smoke pollution forecasts:

Montreal
Singapore

Рекомендация 12 (ИНФОМ-3)

Вклад нетрадиционных источников в Комплексную систему обработки и прогнозирования ВМО

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) решение 53 (ИС-70) «Участие ВМО в глобальных и региональных частных инициативах»;
- 2) резолюцию 80 (Кг-18) «Женевская декларация 2019 года: Формирование сообщества для принятия мер в области погоды, климата и воды»;
- 3) резолюцию 1 (Кг-Внеоч.(2021)) «Единая политика ВМО в области международного обмена данными о системе Земля»;

- 4) [резолюцию 4 \(Кг-Внеоч.\(2021\)\)](#) «Перспективное видение и Стратегия ВМО в области гидрологии и соответствующий План действий»;
- 5) [резолюцию 4 \(Кг-19\)](#) «Инициатива Организации Объединенных Наций „Заблаговременные предупреждения для всех“»;
- 6) резолюцию 3 (СЕРКОМ-3) «Рассмотрение вспомогательных органов Комиссии»;
- 7) [резолюцию 30 \(ИС-76\)](#) «Поправки к *Наставлению по Глобальной системе обработки данных и прогнозирования* (ВМО-№ 485), предложенные Комиссией по наблюдениям, инфраструктуре и информационным системам и Комиссией по обслуживанию и применениям в областях погоды, климата, воды и соответствующих областях окружающей среды» ,

подтверждая необходимость приверженности государственного, частного и научного секторов достижению цели инициативы Организации Объединенных Наций «Заблаговременные предупреждения для всех»,

признавая, что вклад нетрадиционных источников в Комплексную систему обработки и прогнозирования ВМО (КСОПВ) должен быть согласован с принципом единого источника при предоставлении прогнозов паводков и предупреждений о них национальными метеорологическими и гидрологическими службами,

принимая во внимание, что:

- 1) в настоящей рекомендации нетрадиционные источники рассматриваются как структуры, не являющиеся национальными правительственными организациями, такие как частный сектор или международные/межправительственные организации;
- 2) паводки считаются одним из наиболее серьезных опасных явлений в РА I, II, IV и VI , как показано в документе INFCOM-3/INF. 7.1;
- 3) некоторые нетрадиционные источники, такие как Google Flood Hub и инициатива ГЕОГЛОУС Группы наблюдений за Землей (ГЕО), предоставляют продукцию прогнозирования паводков самостоятельно без координации и регулирования со стороны ВМО;
- 4) потребности пользователей в глобальной продукции для прогнозирования речных паводков определяются Членами ВМО, и спецификации для деятельности КСОПВ, касающейся глобального прогнозирования речных паводков, должны быть разработаны в соответствии с выявленными потребностями и учтены в ходе пилотного внедрения глобальной продукции прогнозирования речных паводков в сотрудничестве с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ);
- 5) Координационная группа экспертов по гидрологии на своем шестом заседании в январе 2024 года признала, что существует необходимость в координации деятельности по гидрологическому моделированию и прогнозированию (на основе технических требований, а не географических или временных масштабов), чтобы предотвратить дублирование усилий в рабочих группах технических комиссий, связанных с оперативной гидрологией,

рассмотрев план демонстрации продукции прогнозирования паводков в глобальном масштабе, представленный в документе INFCOM-3/INF. 8.4(3),

приняв во внимание, что ИНФКОМ нуждается в руководстве Исполнительного совета по нетехническим аспектам, связанным с вкладом нетрадиционных источников в КСОПВ, а также в рекомендациях СЕРКОМ по элементам гидрологического прогнозирования в соответствии с Планом действий ВМО в области гидрологии на 2022–2030 годы, который

предписывает СЕРКОМ разработать руководящие принципы и соглашения для поддержки систем заблаговременных предупреждений о паводках и управления рисками,

рекомендует Исполнительному совету принять проект резолюции, представленный в дополнении к настоящей рекомендации.

Дополнение к рекомендации 12 (ИНФОМ-3)

Проект резолюции ##/1 (ИС-78)

Вклад нетрадиционных источников в Комплексную систему обработки и прогнозирования ВМО

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на:

- 1) [решение 53 \(ИС-70\)](#) «Участие ВМО в глобальных и региональных частных инициативах»;
- 2) [резолюцию 80 \(Кг-18\)](#) «Женевская декларация 2019 года: Формирование сообщества для принятия мер в области погоды, климата и воды»;
- 3) [резолюцию 1 \(Кг-Внеоч.\(2021\)\)](#) «Единая политика ВМО в области международного обмена данными о системе Земля»;
- 4) [резолюцию 4 \(Кг-Внеоч.\(2021\)\)](#) «Перспективное видение и Стратегия ВМО в области гидрологии и соответствующий План действий»;
- 5) [резолюцию 29 \(ИС-76\)](#) «Обновление Руководства по Глобальной системе обработки данных (ВМО-№ 305)»;
- 6) [резолюцию 30 \(ИС-76\)](#) «Поправки к *Наставлению по Глобальной системе обработки данных и прогнозирования* (ВМО-№ 485), предложенные Комиссией по наблюдениям, инфраструктуре и информационным системам и Комиссией по обслуживанию и применениям в областях погоды, климата, воды и соответствующих областях окружающей среды»;
- 7) [резолюцию 4 \(Кг-19\)](#) «Инициатива Организации Объединенных Наций „Заблаговременные предупреждения для всех“»;
- 8) [резолюцию 3 \(СЕРКОМ-3\)](#) «Рассмотрение вспомогательных органов Комиссии»;
- 9) [решение 22 \(СЕРКОМ-3\)](#) «Координация и сотрудничество с Советом по исследованиям»,

отмечая, что:

- 1) в настоящей рекомендации под нетрадиционными источниками подразумеваются структуры, не являющиеся национальными правительственными организациями, такие как частный сектор или международные/межправительственные организации, не являющиеся партнерами;
- 2) паводки считаются одним из наиболее серьезных опасных явлений в РА I, II и IV, как показано в документе INFCOM-3/INF. 7.1;

- 3) потребности пользователей в глобальной продукции для прогнозирования речных паводков определяются Членами ВМО, и спецификации для деятельности Комплексной системы обработки и прогнозирования ВМО (КСОПВ), касающейся глобального прогнозирования речных паводков, должны быть разработаны в соответствии с выявленными потребностями и учтены в ходе пилотного внедрения глобальной продукции прогнозирования речных паводков в сотрудничестве с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ),

изучив [рекомендацию 12 \(ИНФКОМ-3\)](#),

признавая растущий потенциал нетрадиционных источников для поддержки метеорологического, гидрологического и климатического обслуживания населения национальными метеорологическими и гидрологическими службами (НМГС),

признавая также критическую важность роли НМГС как единственного официального и авторитетного органа по защите жизни и имущества и то, что вклад нетрадиционных источников в КСОПВ должен соответствовать принципу единого источника при предоставлении прогнозов и предупреждений НМГС о паводках,

учитывая, что Комиссия по наблюдениям, инфраструктуре и информационным системам (ИНФКОМ) нуждается в консультациях, которые будут рассмотрены на ее 4-й сессии, по нетехническим аспектам для рассмотрения вклада нетрадиционных источников в КСОПВ в поддержку метеорологического, гидрологического и климатического обслуживания населения со стороны НМГС, включая следующие пункты независимо от типа организации:

- 1) надлежащее признание/статус нетрадиционных источников в рамках ВМО ;
- 2) роль постоянных представителей Членов при ВМО и их советников по гидрологии, а также предоставляемые ими консультации, и роль президентов региональных ассоциаций и региональных советников по гидрологии при необходимости;
- 3) соблюдение политики взаимодействия государственного и частного секторов, предусмотренной Женевской декларацией, в целях сохранения и укрепления авторитета НМГС для распространения предупреждений и соответствующей информации в поддержку важнейших решений, связанных с опасными природными явлениями и рисками бедствий, и, в частности, уделение особого внимания принципу единого источника при предоставлении НМГС прогнозов паводков и предупреждений о них;
- 4) способы установления ответственного подхода к продукции и обслуживанию, предоставляемым коммерческими организациями для глобального общественного блага, а также их прозрачности и устойчивости,

соглашается разработать руководство по возникающим стратегическим вопросам, включая вышеупомянутые пункты;

порукает ИНФКОМ в сотрудничестве с СЕРКОМ:

- 1) совместно с СЕРКОМ определить потребности пользователей в глобальной продукции по прогнозированию речных паводков, которые должны учитываться при внедрении пилотных глобальных продуктов по прогнозированию речных паводков;
- 2) провести пилотный проект по изучению полезности и технических проблем, связанных с использованием продукции из нетрадиционных источников в КСОПВ для метеорологического, гидрологического и климатического обслуживания населения со стороны НМГС;

- 3) продолжать развивать деятельность КСОПВ, касающуюся глобальной продукции для прогнозирования речных паводков, для удовлетворения выявленных потребностей;
- 4) обновить план пилотных глобальных продуктов по прогнозированию речных паводков с учетом проводимого ВМО пилотного исследования по прогнозированию паводков с помощью искусственного интеллекта, проводимого СЕРКОМ в координации с ИНФКОМ;

порукает Генеральному секретарю призвать НМГС и нетрадиционные источники всех Членов ВМО и партнерских организаций к участию в экспериментальной деятельности и определении потребностей пользователей при поддержке региональных ассоциаций и технических комиссий.

Дополнительную информацию см. в документе INFCOM-3/INF. 8.4(3).

Рекомендация 13 (ИНФКОМ-3)

Четырехлетний план деятельности ВМО, связанной с космической погодой, на 2024—2027 годы

КОМИССИЯ ПО НАБЛЮДЕНИЯМ, ИНФРАСТРУКТУРЕ И ИНФОРМАЦИОННЫМ СИСТЕМАМ,

ссылаясь на:

- 1) [резолюцию 53 \(Кг-18\)](#) «Четырехлетний план деятельности ВМО, связанной с космической погодой, на 2020—2023 годы»,
- 2) [резолюцию 62 \(Кг-19\)](#) «Обзор ранее принятых резолюций Конгресса»,

вновь подтверждая признание:

- 1) влияния космической погоды на такие области, как объекты инфраструктуры наблюдений и телесвязи, безопасность авиации и безопасность на море, энергораспределительные сети и спутниковое навигационное обслуживание,
- 2) потенциальной возможности достижения синергии между предоставлением обслуживания, связанного с космической погодой, и метеорологического обслуживания,

отмечая, что [резолюция 53 \(Кг-18\)](#) остается в силе, но дополнение к ней «Четырехлетний план деятельности ВМО, связанной с космической погодой, на 2020—2023 годы» не было обновлено,

рассмотрев Четырехлетний план деятельности ВМО, связанной с космической погодой, на 2024—2027 годы,

рекомендует Исполнительному совету принять Четырехлетний план деятельности ВМО, связанной с космической погодой, на 2024—2027 годы в соответствии с проектом резолюции, приведенным в дополнении к настоящей рекомендации.

Дополнение к рекомендации 13 (ИНФОМ-3)**Проект резолюции №№/1 (ИС-78)**

ИСПОЛНИТЕЛЬНЫЙ СОВЕТ,

ссылаясь на:

- 1) [резолюцию 53 \(Кг-18\)](#) «Четырехлетний план деятельности ВМО, связанной с космической погодой, на 2020—2023 годы»,
- 2) [резолюцию 62 \(Кг-19\)](#) «Обзор ранее принятых резолюций Конгресса»,

вновь подтверждая признание:

- 1) влияния космической погоды на такие области, как объекты инфраструктуры наблюдений и телесвязи, безопасность авиации и безопасность на море, энергораспределительные сети и спутниковое навигационное обслуживание,
- 2) потенциальной возможности достижения синергии между предоставлением обслуживания, связанного с космической погодой, и метеорологического обслуживания,

отмечая, что [резолюция 53 \(Кг-18\)](#) остается в силе, но дополнение к ней «Четырехлетний план деятельности ВМО, связанной с космической погодой, на 2020—2023 годы» не было обновлено,

памятуя о бюджетных ограничениях, налагаемых [резолюцией 3 \(Кг-19\)](#) «Максимальные расходы на девятнадцатый финансовый период (2024—2027 годы)», в которой Генеральному секретарю поручено в сотрудничестве с Членами мобилизовать внебюджетные ресурсы в целях ускорения, расширения и/или масштабирования осуществления долгосрочных целей и стратегических задач,

рассмотрев [рекомендацию 13 \(ИНФОМ-3\)](#) и дополнение к ней «Четырехлетний план деятельности ВМО, связанной с космической погодой»,

утверждает Четырехлетний план деятельности ВМО, связанной с космической погодой, на 2024—2027 годы, приведенный в дополнении;

порукает Комиссии по наблюдениям, инфраструктуре и информационным системам:

- 1) взять на себя руководство осуществлением деятельности, предусмотренной Четырехлетним планом деятельности ВМО, связанной с космической погодой, на 2024—2027 годы;
- 2) создать оптимальную рабочую и координирующую структуру и механизм в целях:
 - a) решения вопросов, касающихся всех компонентов инфраструктуры;
 - b) взаимодействия с сообществами пользователей обслуживания в области космической погоды в сотрудничестве с Комиссией по метеорологическим, климатическим, гидрологическим, морским и смежным обслуживанию и применениям в области окружающей среды (СЕРКОМ);
 - c) налаживания партнерских связей с соответствующими организациями, такими как Международная служба космической среды (МСКС) и Комитет по космическим исследованиям (КОСПАР), а также другими соответствующими национальными и международными учреждениями;

- 3) представить отчет о достигнутых результатах и внести предложение о будущей деятельности в этой области для рассмотрения на двадцатой сессии Всемирного метеорологического конгресса;

настоятельно призывает Членов оказать поддержку осуществлению Четырехлетнего плана деятельности ВМО, связанной с космической погодой, на 2024—2027 годы путем внесения вкладов в натуральной форме и/или финансовых взносов в Целевой фонд для координации деятельности в области космической погоды.

Дополнение к проекту резолюции №№/1 (ИС-№№)

Четырехлетний план деятельности ВМО, связанной с космической погодой

ЧЕТЫРЕХЛЕТНИЙ ПЛАН ДЕЯТЕЛЬНОСТИ ВМО, СВЯЗАННОЙ С КОСМИЧЕСКОЙ ПОГОДОЙ, НА 2024–2027 ГОДЫ

ПРОЕКТ 1.0

12 февраля 2024 года

ВВЕДЕНИЕ

Явления космической погоды обусловлены процессами, происходящими на Солнце и в межпланетном пространстве. Эти явления могут в конечном итоге оказывать воздействие на природную среду Земли в региональном и глобальном масштабах. Возмущения космической погоды могут оказывать воздействие на некоторые технологии, имеющие критически важное значение, влияя тем самым на мировую экономику. Необязательно создавая непосредственную угрозу человеческой жизни на Земле, неблагоприятные воздействия на объекты энергетической инфраструктуры, транспортные системы, использование Глобальной навигационной спутниковой системы (ГНСС), спутниковые службы и пр., возникающие вследствие взаимосвязей современного общества, приводят к снижению надежности критически важных систем, что может иметь потенциальные последствия для безопасности и здоровья человека.

Для успешного смягчения вредных воздействий космической погоды мощная наблюдательная база на Земле и в космосе (от Солнца до Земли) должна подкрепляться возможностями численного моделирования, осуществляемого с учетом как самих явлений, так и их технологических воздействий. В настоящее время задача прогнозирования возможных воздействий космической погоды связана с определенными трудностями. Несмотря на недавние успехи, методы далеко не соответствуют потребностям пользователей, и положение дел в этой области может быть значительно улучшено. Задачи, которые ставит космическая погода, превосходят возможности отдельных стран, и поэтому их лучше всего решать посредством скоординированных усилий, в реализацию которых Всемирная метеорологическая организация (ВМО) может внести существенный вклад.

В 2015 году Семнадцатый Всемирный метеорологический конгресс (Кг-17) согласился с тем, что ВМО следует участвовать в координации международного оперативного мониторинга и прогнозирования космической погоды для более эффективного поддержания защиты жизни людей, имущества и критически важных объектов инфраструктуры, а также затронутых видов экономической деятельности. Предоставляя глобальную межправительственную рамочную основу, ВМО будет содействовать выполнению международных обязательств и способствовать созданию оперативных видов обслуживания, связанных с космической погодой.

В результате этих усилий ВМО будет достигнута более эффективная координация космических и наземных системы наблюдений за космической погодой за счет приведения их в соответствие с принципами ИГСНВ; будет оптимизирована обработка данных за счет соответствующего размещения в Комплексной системе обработки и прогнозирования ВМО (КСОПВ, ранее известная как Глобальная система обработки данных и прогнозирования (ГСОДП)); Членам будет доступна согласованная прошедшая контроль качества продукция в области космической погоды через Информационную систему ВМО (ИСВ); и будет обеспечен переход от научных знаний о космической погоде к оперативной практике. Ожидается, что план будет способствовать дальнейшей эффективной координации с инициативами, реализуемыми за пределами ВМО, и обеспечит долгосрочное улучшение обслуживания в области космической погоды. Для стандартизации компетенций персонала, занимающегося предоставлением обслуживания, связанного с космической погодой, в качестве примера могут быть использованы передовые практики и руководящие указания для метеорологического персонала, задокументированные ВМО, в целях разработки аналогичных передовых практик для персонала, занимающегося вопросами космической погоды, которые затем могут быть использованы центрами космической погоды в их учебной деятельности.

Справочная информация

Поскольку потребности в наблюдениях за космической погодой были определены в рамках регулярного обзора потребностей (РОП) ВМО, Кг-17 в 2015 году поручил включить наблюдения за космической погодой в ИГСНВ¹⁵⁷. Необходимо использовать интегративный подход в отношении обмена и управления данными в рамках ИСВ, обработки данных в рамках КСОПВ, ранее известной как Глобальная система обработки данных и прогнозирования (ГСОДП), и обслуживания в поддержку принятия решений в рамках деятельности по предоставлению обслуживания и снижению риска бедствий.

В связи с этим Кг-17 поручил Комиссии по авиационной метеорологии (КАМ) и Комиссии по основным системам (КОС) при завершении работы над проектом Четырехлетнего плана на 2016—2019 годы принять во внимание существующие обязанности, рабочие механизмы, экспертные группы и интеграцию в соответствующие программы ВМО и представить его Исполнительному совету с рекомендацией утвердить. Кг-17 также поручил Генеральному секретарю ВМО оказать поддержку деятельности, определенной в Плане, в партнерстве с другими соответствующими организациями, такими как Международная служба космической среды (МСКС), а также национальными и международными учреждениями; и представить восемнадцатой сессии Всемирного метеорологического конгресса (Кг-18) в 2019 году доклад и предложение по дальнейшей деятельности в этой области.

В 2016 году шестьдесят восьмая сессия Исполнительного совета (ИС-68) утвердила Четырехлетний план на 2016—2019 годы¹⁵⁸ и поручила КАМ и КОС учредить Межпрограммную группу по информации, системам и обслуживанию в области космической погоды (МПГ-ИСОКП).

ИС-68 признал влияние космической погоды на такие области, как объекты инфраструктуры наблюдений и телесвязи, безопасность авиации и безопасность на море, энергораспределительные сети и спутниковое навигационное обслуживание. ИС-68 также учел потенциальную возможность достижения синергии между предоставлением обслуживания в области космической погоды и метеорологического обслуживания; признал необходимость согласованных действий Членов для решения вопросов, связанных с потребностями в наблюдениях и обслуживании в целях защиты от опасных явлений космической погоды, как отмечалось шестнадцатой сессией Всемирного метеорологического конгресса; и подчеркнул необходимость оказания поддержки работе, проводимой совместно с ИКАО, по обеспечению оперативного обслуживания в области космической погоды для международной аэронавигации к 2018 году (**решение 33 (ИС-68)** «Четырехлетний план деятельности ВМО, связанной с космической погодой»).

¹⁵⁷ <https://community.wmo.int/en/rolling-review-requirements-process-2023-version>

¹⁵⁸ ИС-68: Часть I — Сокращенный окончательный отчет, с. 135—163.

МПГ-ИСОКП была создана при участии 23 стран, являющихся Членами ВМО, и шести ассоциированных членов из Организации Объединенных Наций и межправительственных организаций. Эта группа продолжила работу Межпрограммной координационной группы по космической погоде (МКГКП), основанной в 2010 году, по выполнению задач, определенных Четырехлетним планом на 2016—2019 годы. Ее первое заседание, МПГ-ИСОКП-1, состоялось в июне 2017 года. Члены МПГ-ИСОКП провели обзор рабочего плана, который был описан в Четырехлетнем плане на 2016—2019 годы, и разбили его на отдельные пункты действий. Эти пункты действий были распределены между следующими целевыми группами, созданными в рамках МПГ-ИСОКП:

- ЦГ-СИС: основные системы в области космической погоды, включая вопросы, связанные с методами и сетями наблюдений, управлением и обменом данными, центрами данных и космической климатологией;
- ЦГ-СЦИ: научные знания о космической погоде, в том числе вопросы, касающиеся моделирования, оценки и верификации моделей, взаимодействия с климатом и перехода от научных исследований к оперативной практике;
- ЦГ-АПП: применения в области космической погоды, в том числе оценка потребностей, предоставление обслуживания, наращивание потенциала и взаимодействие с пользователями;
- специальная ЦГ-АВИ: космическая погода в интересах авиации, в том числе вопросы, касающиеся разработки процедур аудита для идентификации центров космической погоды, способных предоставлять обслуживание в области космической погоды для авиации.

В 2018 году семидесятая сессия Исполнительного совета (ИС-70) постановила, чтобы КОС в координации с КАМ разработала новый «Четырехлетний план мероприятий ВМО по координации деятельности, связанной с космической погодой, на 2020—2023 годы», именуемый в дальнейшем «Четырехлетний план на 2020—2023 годы». Четырехлетний план на 2020—2023 годы, который был принят на Кг-18 в соответствии с резолюцией 53, преследовал две цели. Во-первых, в нем был изложен Четырехлетний план деятельности ВМО, связанной с космической погодой, на 2020—2023 годы. Во-вторых, он включал в себя отчет о результатах и достижениях. Планировалось продолжить деятельность МПГ-ИСОКП в рамках предложенной рабочей структуры по результатам реформы ВМО. Однако в связи с реорганизацией после реформы ВМО МПГ-ИСОКП не продолжила работу в рамках предложенной структуры.

Вместо этого в 2022 году при Комиссии по наблюдениям, инфраструктуре и информационным системам (ИНФКОМ) была создана новая Экспертная группа по космической погоде (ЭГ-КП). ЭГ-КП было поручено координировать с соответствующими органами ВМО разработку положений Технического регламента и руководящего материала ВМО, а также других соответствующих документов по всем аспектам, связанным с космической погодой. Она продолжает проводить работу, проделанную МПГ-ИСОКП, но с более широким мандатом.

Настоящий «Четырехлетний план деятельности ВМО, связанной с космической погодой, на 2020—2027 годы» (именуемый в дальнейшем «Четырехлетний план на 2024—2027 годы») представляет собой адаптацию предыдущего Четырехлетнего плана на 2020—2023 годы, включая обновления, отражающую новую структуру ВМО после проведения реформы и последние изменения в координации с другими организациями.

Цели высокого уровня

Возможности наблюдений, понимание и прогнозирование явлений космической погоды выиграют от большей и лучшей координации, и необходимо достичь следующих целей высокого уровня:

- 1) содействовать обеспечению доступности, качества и функциональной совместимости данных наблюдений, которые необходимы для поддержки обслуживания в области космической погоды, используя опыт ИНФКОМ и Постоянного комитета по системам наблюдений за Землей и сетям мониторинга (ПК-СНСМ);
- 2) совершенствовать процессы сбора данных и информации о космической погоде, обмена ими и их предоставления при помощи открытого совместного использования данных, стандартов, согласованных на международном уровне, и скоординированных процедур, используя возможности ИСВ, ИГСНВ и КСОПВ; и, следовательно, опираясь на экспертные знания и опыт Постоянного комитета по управлению информацией и информационным технологиям (ПК-УИИТ), Постоянного комитета по системам наблюдения за Землей и Постоянного комитета по обработке данных для прикладных аспектов моделирования и прогнозирования системы Земля (ПК-МПСЗ);
- 3) выявлять пробелы в данных и обслуживании, используя такие подходы ВМО, как РОП и анализ пробелов, а также регулярные обновления заявления о руководящих принципах для наблюдений и обслуживания в области космической погоды; поощрять улучшение предоставления данных и обслуживания путем определения приоритетности основных видов обслуживания;
- 4) содействовать развитию новых экономически эффективных и имеющих высокую ценность видов обслуживания, выявляя и рассматривая потребности пользователей, обращая особое внимание на те сектора, в которых необходимо принятие согласованных на международном уровне мер реагирования, в координации с основными секторами применений;
- 5) содействовать достижению синергии между сообществами, занимающимися вопросами космической погоды и метеорологии, и метеорологической деятельностью; поощрять участие Членов ВМО в предоставлении обслуживания в области космической погоды, опираясь на пример центров МСКС и другие примеры признанных поставщиков обслуживания; использовать, по мере возможности, опыт ВМО в области численного прогнозирования погоды и других соответствующих программ ВМО в целях повышения точности, надежности, функциональной совместимости и общей экономической эффективности предоставления обслуживания, связанного с космической погодой;
- 6) содействовать развитию методов анализа, моделирования и прогнозирования космической погоды, позволяющих предоставлять оперативное обслуживание, опирающееся на максимально качественную научную основу; способствовать передаче технических и научных достижений от научных исследований к оперативной практике;
- 7) обеспечить руководящие принципы в отношении подготовки кадров и наращивания потенциала на основе существующей документации ВМО в области метеорологии и в соответствии с ней для развития навыков подготовки и интерпретации продукции и обслуживания, связанных с космической погодой, с тем чтобы позволить Членам ВМО полноценным образом применять имеющуюся информацию и наращивать свой собственный потенциал в области предоставления обслуживания. Эти руководящие принципы также могут использоваться в менеджменте качества обслуживания на национальном уровне;
- 8) совершенствовать процедуры предупреждения о чрезвычайных ситуациях и повышать глобальную готовность к опасным явлениям космической погоды в соответствии со Стратегией ВМО по снижению риска бедствий.

Практическая «дорожная карта» для осуществления обслуживания в области космической погоды в рамках программ ВМО

Конгресс признает возрастающий социальный спрос на обслуживание в области космической погоды в связи с ростом зависимости от технологий, подвергающихся воздействию космической погоды, включая службы радиосвязи, спутники для наблюдений за Землей и навигационные спутники. В ряде стран разрабатываются процедуры управления рисками суровых явлений, связанных с космической погодой, в рамках подхода к снижению риска бедствий, учитывающего многие опасные явления. Обслуживание в области космической погоды регулярно используется коммерческими авиакомпаниями, спутниковой индустрией, при проведении буровых и топографо-геодезических работ, электросетевыми организациями, при проектировании трубопроводов, а также пользователями спутниковых навигационных систем. Ожидается, что этот спрос будет расширяться по мере повышения осведомленности о воздействии явлений космической погоды, растущего воздействия на общество и эволюции продукции и обслуживания, связанных с космической погодой.

Первые результаты деятельности МКГКП в течение шестнадцатого финансового периода (2012—2015 годы) и МПГ-ИСОКП в течение семнадцатого финансового периода (2016—2019 годы), которые перешли в ведение ЭГ-КП в 2022 году, указывают на широкий спектр видов деятельности, которым может принести пользу участие ВМО в деятельности, связанной с космической погодой, и демонстрируют, как ВМО может эффективно способствовать достижению прорыва в этой области и играть общепризнанную роль в международном сообществе, занимающемся вопросами космической погоды. Учитывая установленные требования к обслуживанию информацией о космической погоде в авиации, а также растущий спрос со стороны других секторов, рекомендуется, чтобы в течение девятнадцатого финансового периода (2024—2027 годы) и в последующий период ВМО продолжала участвовать и расширять свое участие в этой деятельности в целях создания устойчивой основы для предоставления глобального и надежного обслуживания в области космической погоды.

Деятельность ВМО по координации осуществления обслуживания в области космической погоды в рамках программ ВМО в целях совершенствования процедур предупреждения о чрезвычайных ситуациях и повышения глобальной готовности к опасным явлениям космической погоды в соответствии со Стратегией ВМО по снижению риска бедствий будет обеспечена за счет более эффективного сбора данных и информации о космической погоде, обмена ими и их предоставления при помощи открытого совместного использования данных, стандартов, согласованных на международном уровне, и скоординированных документированных процедур. Содействие производству высококачественной конечной продукции и видов обслуживания Членами ВМО, а также использование принципов ИСВ, разработка передовых практик и системы качества, повышение точности, надежности и функциональной совместимости приведут к обеспечению общей экономической эффективности предоставления обслуживания.

Рекомендуемые процедуры предоставления обслуживания в области космической погоды будут описаны в Наставлении по КСОПВ и соответствующих положениях Технического регламента ВМО и будут представлены на утверждение двадцатой сессии Всемирного метеорологического конгресса (Кг-20) в 2027 году.

Выгоды

Ожидается, что настоящий план действий может принести значительные выгоды Членам ВМО с точки зрения повышения точности наблюдений и повышения надежности, точности и своевременности прогнозов и предупреждений, предоставляемых их пользователям. Достигшее максимального уровня развития обслуживание в области космической погоды может стать источником получения выгоды для поставщиков информации (например, механизм возмещения расходов на обязательные, согласно требованиям ИКАО, виды обслуживания, обслуживание оповещениями энергосетей, а также

операторов телесвязи и ГНСС). Потенциальные выгоды от деятельности ВМО, связанной с космической погодой, изложены в докладе, подготовленном в 2008 году¹⁵⁹.

ДОСТИЖЕНИЯ И ДЕЯТЕЛЬНОСТЬ В 2016–2023 ГГ.

Подробный отчет о деятельности в период 2016—2019 годов приведен в приложении 1 к предыдущему Четырехлетнему плану, утвержденному [резолюцией 53 \(Кг-18\)](#). Некоторые основные моменты:

- 1) обновленное заявление о руководящих принципах ВМО;
- 2) включение космической погоды в базу данных Инструмента анализа и обзора возможностей систем наблюдений (ОСКАР) ВМО и РОП ВМО;
- 3) аудиторская проверка ИКАО потенциальных кандидатов, отвечающих за предоставление информации о космической погоде для обслуживания аэронавигации, при участии ВМО;
- 4) создание перечня соответствующих частот для космической погоды в рамках подготовки к Всемирной конференции радиосвязи (ВКР) Международного союза электросвязи (МСЭ).

Многие из этих видов деятельности продолжились, когда МПГ-ИСОКП прекратила свое существование в рамках реформы ВМО. После учреждения новой ЭГ-КП в июне 2022 года она продолжила эту деятельность, за исключением пункта 3), работа по которому была выполнена.

В частности, ЭГ-КП за это время завершила работу по пункту 4) в сотрудничестве с Экспертной группой по координации радиочастот. В результате были достигнуты отличные результаты на Всемирной конференции радиосвязи 2023 года, конференции, которая проводится раз в четыре года и на которой МСЭ обновляет Регламент радиосвязи — глобальный договор, регулирующий радиочастотный спектр и спутниковые орбиты:

- космическая погода теперь получила признание в Регламенте радиосвязи в статье 29B — *Радиослужба, связанная с наблюдениями за космической погодой*, что позволило отнести космическую погоду к специальной «службе радиосвязи», а именно ВСМ (космическая погода);
- в повестку дня Всемирной конференции радиосвязи был включен новый пункт 1.17, который потенциально может привести к первичному выделению нескольких определенных полос частот для службы ВСМ (космическая погода).

Работа МПГ-ИСОКП уже привела к включению космической погоды в некоторые виды деятельности ВМО в соответствии с несколькими резолюциями, принятыми на Кг-18 в 2019 году, ИС-76 и внеочередной сессии Конгресса в 2021 году:

- включение явлений космической погоды в каталогизацию опасных явлений ([резолюция 12 \(Кг-18\)](#));
- включение космической погоды в Глобальную систему оповещения о многих опасных явлениях ([резолюция 13 \(Кг-18\)](#));
- Стратегия Виртуальной лаборатории для образования и подготовки кадров в области спутниковой метеорологии на 2020—2025 годы ([резолюция 52 \(Кг-18\)](#)), а также на 2024—2027 годы ([резолюция 33 \(ИС-76\)](#)) прямо предусматривает подготовку кадров для целей космической погоды;

¹⁵⁹ The Potential Role of WMO in Space Weather (Потенциальная роль ВМО в отношении космической погоды) (SP-5, апрель 2008 г.). [The potential role of WMO in Space Weather](#) (Потенциальная роль ВМО в отношении космической погоды) (WMO/TD-No. 1482).

- Единая политика ВМО в области международного обмена данными о системе Земля ([резолюция 1 \(Кг-Внеоч.\(2021\)\)](#)) включает раздел, посвященный данным о космической погоде.

ПРИОРИТЕТНЫЕ ВИДЫ ДЕЯТЕЛЬНОСТИ

Следующие конкретные виды деятельности будут направлены на реализацию целей высокого уровня, описанных в разделе 1.3. Эти виды деятельности в значительной степени являются продолжением деятельности, осуществляемой в рамках предыдущего Четырехлетнего плана на 2020—2023 годы. В рамках текущего плана больше внимания уделяется подготовке необходимой нормативно-технической документации для ее полного включения в структуру ВМО.

А Применение процедур ВМО для улучшения доступности данных о космической погоде за счет скоординированного сбора и повышения значимости данных

- i) Продолжение интеграции в ОСКАР/Поверхность метаданных наземных систем наблюдений за космической погодой;
- ii) составление всеобъемлющего пошагового руководства по включению в ОСКАР/Поверхность метаданных наземных систем наблюдений, в частности, с учетом случаев, когда они эксплуатируются организациями, не относящимися к ВМО;
- iii) обновление метаданных космических наблюдений в базе данных ОСКАР/Поверхность (с соответствующими организациями);
- iv) регулярное проведение обзора существующих возможностей наблюдений с целью выявления рисков и/или недостатков в их устойчивой поддержке основных видов обслуживания, а также с целью содействия реализации [Перспективного видения в отношении Интегрированной глобальной системы наблюдений ВМО в 2040 году](#) (ВМО-№ 1243);
- v) поощрение и направление усилий существующих поставщиков информации о космической погоде (в том числе не относящихся к НМГС, например, членов МСКС), чтобы они предоставляли свои данные и продукцию через ИСВ. Таким образом обеспечивается глобальная доступность наблюдений и прогнозов не только для использования в обслуживании оповещениями, но и для взаимных сравнений и проверки оправдываемости прогнозов;
- vi) обзор потребностей пользователей и выявление приоритетных областей (например, авиации) на основе РОП;
- vii) указание данных наблюдений, данных анализа и прогнозов космической погоды, а также рекомендаций и предупреждений, которые подлежат обмену в качестве основных данных в рамках Единой политики ВМО в области данных;
- viii) в сотрудничестве с Экспертной группой по координации радиочастот содействие проведению исследований МСЭ, касающихся возможной защиты полос радиочастот, используемых для обслуживания в области космической погоды. В частности, при подготовке пункта 1.17 повестки дня Всемирной конференции радиосвязи 2027 года.

В Улучшение стандартизации, качества и функциональной совместимости данных

- i) Пересмотр и обновление стандарта метаданных наблюдений ИГСНВ с целью его применения и включения в него наблюдений за космической погодой;
- ii) для всех типов основных наблюдений за космической погодой составление требований для включения в Наставление по ИГСНВ и Руководство по ИГСНВ. Для тех типов данных, стандарты которых существуют под эгидой других международных организаций, должны быть определены и установлены каналы координации с этими организациями, чтобы существующие стандарты могли быть приняты с минимальными нарушениями;
- iii) изучение цепочек обработки данных, задействованных в предоставлении обслуживания в области космической погоды и разработка соответствующего подхода для интеграции (частей) цепочки обработки данных в КСОПВ. Предполагается, что это приведет к выявлению и уточнению стандартной продукции обработки и требований к центрам ее производства для включения в Наставление по ИСВ и Наставление по КСОПВ соответственно, с должным учетом функциональных возможностей, которые реализуются / могут реализовываться учреждениями, не являющимися НМГС.

С Предоставление оперативного обслуживания, опирающегося на максимально более качественную научную основу

- i) Координация действий с международными организациями, такими как МСКС и Комитет по космическим исследованиям (КОСПАР), и определение передовых практик валидации и оценки оперативного обслуживания с учетом имеющихся метеорологических знаний и опыта в этих процедурах;
- ii) сбор и сохранение информации об оперативных моделях космической погоды и их эффективности;
- iii) где это необходимо, содействие проведению практических семинаров для активизации обсуждения вопросов, изложенных выше в пунктах i) и ii);
- iv) составление списка с перечислением в порядке приоритетности существующих научных барьеров для существенных изменений в оперативном обслуживании в области космической погоды (таких как невозможность прогнозирования магнитной структуры выбросов коронарной массы и т. д.) в координации с Группой экспертов КОСПАР по космической погоде¹⁶⁰;
- v) устранение пробелов в знаниях, упомянутых в пункте iv), например, посредством организации тематических практических семинаров или поощрения взаимодействия между членами ЭГ-КП и соответствующими исследователями;
- vi) документирование потенциальной возможности более широкого использования методов усвоения данных для обслуживания в области космической погоды. Принятие необходимых мер для устранения оперативных препятствий и подготовка руководящего материала для оптимального использования усвоения данных в обслуживании в области космической погоды;
- vii) изучение возможности использования и потенциала новых методов, таких как машинное обучение и искусственный интеллект, для оперативного обслуживания в области космической погоды.

¹⁶⁰ <https://cosparhq.cnes.fr/scientific-structure/panels/panel-on-space-weather-psw/>

D Содействие достижению научной синергии между сообществами, занимающимися вопросами космической погоды и метеорологии/климата

- i) Обсуждение с метеорологическими сообществами взаимосвязи между процессами, связанными с космической погодой, и метеорологическими и климатическими процессами. Оно может опираться на результаты недавних сессий конференции Европейского метеорологического общества (ЕМО) «Взаимосвязь между Солнцем, космической погодой и атмосферой» и на работу по подготовке к будущим сессиям ЕМО в этой же области;
- ii) координация обсуждений с другими международными организациями вопросов воздействия космической погоды на метеорологические и климатические процессы. Где это необходимо, содействие проведению практических семинаров для активизации обсуждения этих вопросов;
- iii) размещение на веб-сайте ВМО отчетов и рекомендаций в отношении дальнейших шагов, вытекающих из результатов вышеупомянутых практических семинаров, связанных с космической погодой, с целью содействия популяризации работы и изложения плана действий для дальнейшего развития.

E Предоставление информации, подготовка кадров и наращивание потенциала

- i) Предоставление руководящих указаний правительствам по вопросам оценки их рисков, связанных с космической погодой;
- ii) дальнейшая разработка структуры подготовки кадров и наращивания потенциала в области космической погоды на разных уровнях квалификации и для разной целевой аудитории. Обслуживание ИКАО, связанное с космической погодой, может быть хорошим испытательным полигоном для подготовки кадров и наращивания потенциала;
- iii) дальнейшее улучшение доступности соответствующей информации о космической погоде для всех Членов ВМО в качестве неотъемлемой части наращивания потенциала;
- iv) выявление возможностей для обеспечения правительств и регулирующих органов количественной информацией о рисках, связанных с космической погодой (например, оценки рисков).

СОТРУДНИЧЕСТВО С ОРГАНИЗАЦИЕЙ ОБЪЕДИНЕННЫХ НАЦИЙ И МЕЖПРАВИТЕЛЬСТВЕННЫМИ ОРГАНИЗАЦИЯМИ

Космическая погода — глобальное природное явление, и сотрудничество со многими организациями будет способствовать осуществлению наблюдений, пониманию, моделированию, предсказанию и даже смягчению последствий в контексте снижения риска. Сотрудничество налажено на всех уровнях и будет продолжено:

- на уровне пользователей (например, ИКАО, международных организаций, регулирующих поставки электроэнергии, международной организации по обслуживанию ГНСС),
- на уровне производства наблюдений (например, по линии международных космических программ в сотрудничестве с Координационной группой по метеорологическим спутникам (КГМС), международного сотрудничества в области наземного мониторинга (например, INTERMAGNET, IGS),

а также в рамках международного сотрудничества в области научных достижений (например, КОСПАР), обслуживания и эксплуатации (например, МСКС) и других видов сотрудничества (например, Комитет Организации Объединенных Наций по использованию космического пространства в мирных целях (КОПУОС ООН)).

Ниже приведены некоторые примеры значительных достижений.

Сотрудничество с ИКАО в целях содействия развитию глобальной рамочной основы для обеспечения авиационных пользователей информацией о космической погоде

На седьмом совещании своей 215-й сессии, состоявшемся 13 ноября 2018 году, Совет ИКАО в ходе обсуждения вопроса о предоставлении обслуживания информацией о космической погоде согласился с тем, что функционирование трех глобальных центров космической погоды будет обеспечиваться Панъевропейским консорциумом служб космической погоды для авиации (ПЕКАСУС) (во главе с Финляндией, в составе Бельгии, Соединенного Королевства, Польши, Германии, Нидерландов, Италии, Австрии и Кипра), Соединенными Штатами Америки и консорциумом АКФЯ (в составе Австралии, Канады, Франции и Японии). Помимо этого, Совет ИКАО согласился с тем, что не позднее ноября 2022 года будут созданы два региональных центра — в Южной Африке и на базе консорциума в составе Китая и Российской Федерации. Позднее было решено, что консорциум в составе Китая и Российской Федерации будет играть роль дополнительного глобального, а не регионального центра.

Выбор и назначение этих центров были достигнуты, в частности, благодаря прекрасному межучрежденческому сотрудничеству и координации между ИКАО и ВМО.

Межучрежденческое сотрудничество, подобное описанному выше, демонстрирует, как можно обеспечить потребности лиц, принимающих решения в областях, ориентированных на обслуживание, таких как авиация, когда ВМО обеспечивает основу для налаживания партнерских связей между научным сообществом, занимающимся вопросами космической погоды, и метеорологическим сообществом.

Та роль, которую играет ВМО через МПГ-ИСОКП, получила признание и поддержку на международном уровне. Сотрудничество с ИКАО в осуществлении процесса активизации обслуживания определяется не только как деятельность как таковая, но и с точки зрения более полного участия ВМО в поддержке сектора международной гражданской авиации в вопросах, связанных с космической погодой.

ВМО продолжит играть активную и вспомогательную роль вместе с ИКАО в деле обеспечения и развития глобального обслуживания информацией о космической погоде в поддержку международной аэронавигации. Такая поддержка будет включать информационно-разъяснительную работу в отношении надлежащих технических методов и практик, необходимых для предоставления обслуживания информацией о космической погоде в соответствии с существующими и предполагаемыми будущими потребностями авиации. ВМО будет работать с ИКАО и ее партнерами в целях наращивания потенциала и возможностей назначенных центров на основе сотрудничества, в том числе посредством совместного использования информации и содействия распространению передовых практик для обеспечения согласованного обслуживания.

Сотрудничество с МСКС в целях консолидации функционирующей глобальной рамочной основы для мониторинга и прогнозирования космической погоды

Сотрудничество между МСКС и ЭГ-КП ВМО поддерживается за счет членства, так как большинство членов ЭГ-КП являются представителями региональных центров МСКС по выпуску предупреждений.

С МСКС было заключено рабочее соглашение путем обмена письмами, официально закрепляющими сотрудничество с этой организацией, которая является инициатором и движущей силой деятельности ВМО в области космической погоды. В этом соглашении

МСКС и ВМО заявляют о своем намерении действовать в тесном сотрудничестве в целях содействия совершенствованию и координации оперативного обслуживания в области космической погоды, предоставляемого Членами ВМО и центрами МСКС.

МСКС и ВМО будут осуществлять эту деятельность посредством проведения совместных технических совещаний и практических семинаров, а также посредством скоординированных коммуникационных и информационно-просветительских мероприятий. В частности, МСКС и ВМО будут:

- информировать друг друга относительно всех программ работы, видов деятельности и публикаций по вопросам, которые могут представлять взаимный интерес;
- вносить совместный вклад в стандартизацию оперативных наблюдений за космической погодой, управления данными, производства и распространения продукции; а также в спецификацию видов обслуживания информацией о космической погоде и разработку передовых практик, например, для аварийных предупреждений и принятия принципов Findable, Accessible, Interoperable, and Reusable (FAIR) (удобные для поиска, доступные, функционально совместимые и многократно используемые) при распространении открытых данных;
- способствовать повышению осведомленности населения о космической погоде и ее воздействии и поддерживать деятельность по обеспечению готовности к экстремальным явлениям космической погоды;
- проводить совместные исследования потребностей текущего и будущего обслуживания в области космической погоды;
- способствовать внедрению научных знаний о космической погоде в оперативное обслуживание общества.

Сотрудничество с КОСПАР в целях расширения деятельности по подготовке кадров и наращиванию потенциала в области космической погоды

Необходимость укрепления международной координации регулярно подчеркивается международными органами, участвующими в научных исследованиях в области космической погоды, такими как Группа экспертов КОСПАР по космической погоде. 21 марта 2012 года между ВМО и КОСПАР был подписан Меморандум о взаимопонимании, предусматривающий установление связи по линии Виртуальной лаборатории по образованию и подготовке кадров (ВЛаб), созданной ВМО и КГМС. Срок действия Меморандума продлевался в 2015 и 2018 годах. Посредством этого соглашения ВМО и КОСПАР осуществляли следующие виды совместной деятельности:

- обмен информацией о деятельности по наращиванию потенциала;
- обмен информацией о контактных лицах;
- взаимное признание и взаимное продвижение;
- сотрудничество ВЛаб КГМС-ВМО с принимающими учреждениями КОСПАР и партнерами из числа спутниковых операторов по линии организации мероприятий в области наращивания потенциала;
- обеспечение взаимного спонсорства на мероприятиях в области наращивания потенциала (в натуральной форме);
- изучение дополнительных возможностей для установления партнерских отношений.

Сотрудничество с Группой экспертов КОСПАР по космической погоде в поддержку передачи знаний в контексте перехода от научных исследований к оперативной практике в последние годы активизировалось после того, как Управление Организации Объединенных Наций по вопросам космического пространства (УВКП ООН) обратилось к ВМО, МСКС и КОСПАР с призывом совместно возглавить работу в этой области (см. раздел 4.4).

Координация и сотрудничество в рамках КОПУОС Организации Объединенных Наций

КОПУОС, Комитет по использованию космического пространства в мирных целях Генеральной Ассамблеи Организации Объединенных Наций, был создан в 1959 году для управления исследованием и использованием космоса на благо всего человечества: во имя мира, безопасности и развития. Задачами работы Комитета являются обозрение международного сотрудничества в области использования космического пространства в мирных целях, изучение видов деятельности, связанных с космосом, которые могла бы осуществлять Организация Объединенных Наций, поощрение мер по претворению в жизнь программ космических исследований и изучение правовых проблем, возникающих при исследовании космического пространства. УВКП Секретариата Организации Объединенных Наций выполняет функции Секретариата КОПУОС.

В течение многих лет КОПУОС рассматривает космическую погоду в рамках отдельного пункта повестки дня сессий своего Научно-технического подкомитета. Группа экспертов по космической погоде действовала в соответствии с многолетним планом работы, направленным на создание международной координационной группы по космической погоде, которая должна обеспечить улучшение международного сотрудничества и координации в целях предоставления более качественного обслуживания в области космической погоды и в конечном итоге повышение глобальной устойчивости к неблагоприятным воздействиям космической погоды. В заключительном докладе ([A/AC.105/C.1/L.401](#)) Группы экспертов по космической погоде содержится ряд рекомендаций, в том числе призыв к ВМО, МКСК и Комитету по исследованию космического пространства (КОСПАР) возглавить усилия по улучшению глобальной координации деятельности в области космической погоды на основе консультаций и взаимодействия с другими соответствующими субъектами и международными организациями. После получения письма с официальной просьбой от УВКП в июле 2022 года три организации согласились возглавить эту работу и совместно предприняли ряд инициатив по обеспечению перекрестного представительства и осуществляли взаимодействие с другими международными организациями, например, в рамках [Международного координационного форума по космической погоде](#), который был проведен в ВМО 17 ноября 2023 года.

УВКП также отвечает за выполнение обязанностей Генерального секретаря согласно [международному космическому праву](#) и осуществляет Программу Организации Объединенных Наций по применению космической техники, согласно которой в рамках ее Инициативы по фундаментальной космической науке (ИФКН)¹⁶¹ проводится ряд мероприятий, связанных с космической погодой.

В частности, ИФКН вносит вклад в наращивание потенциала в развивающихся странах, способствуя их участию в деятельности, связанной с космической погодой, в рамках Международной инициативы по космической погоде (МИКП)¹⁶². МИКП — это программа международного сотрудничества по совершенствованию научных знаний о космической погоде за счет установки приборов, анализа и интерпретации данных о космической погоде, полученных с размещенных приборов, в сочетании с космическими данными и представлению результатов населению и студентам. Это деятельность, осуществляемая по итогам успешно проведенного в 2007 году Международного гелиофизического года ([МГГ-2007](#)) и сосредоточенная исключительно на космической погоде.

Помимо этого, УВКП действует как Секретариат Международного комитета по глобальным навигационным спутниковым системам (МКГ), который также осуществляет ряд инициатив в области космической погоды, связанных с МИКП.

¹⁶¹ <http://www.unoosa.org/oosa/en/ourwork/psa/bssi/index.html>

¹⁶² <http://www.iswi-secretariat.org/>

Координация и сотрудничество ВМО с КОПУОС и УВКП будут иметь две основные цели:

- 1) обеспечение учета Группой экспертов КОПУОС по космической погоде деятельности ВМО, связанной с космической погодой, в ее работе по созданию международной координационной группы по космической погоде;
- 2) сотрудничество с УВКП в рамках Программы ООН по применению космической техники и МКГ и в рамках Международной инициативы по космической погоде для координации деятельности по наращиванию потенциала в области космической погоды.

Общая координация с КОПУОС осуществляется в ходе ежегодных сессий КОПУОС и его Научно-технического подкомитета, на которых регулярно присутствует ВМО.

ВМО также может участвовать в соответствующей деятельности по наращиванию потенциала в области космической погоды, организуемой УВКП в рамках Программы ООН по применению космической техники или в рамках деятельности МКГ. Координация этой деятельности также осуществляется в рамках «ООН-космос» и ежегодных сессий Межучрежденческого совещания по космической деятельности Организации Объединенных Наций.

РЕСУРСЫ

В настоящем плане действий указаны мероприятия, которые необходимо реализовать, но не описаны темпы, с которыми следует ожидать прогресса в решении этих вопросов. Темпы зависят от ресурсов, выделенных на эту деятельность.

На минимальном уровне это предполагает дальнейшее участие Членов посредством своих экспертов в области космической погоды в работе ГЭ-КП при поддержке Секретариата в режиме частичной нагрузки.

Однако для перехода к фактической реализации, позволяющей совершить прорыв и получить ощутимые преимущества в нескольких областях применения, необходимо дальнейшее участие членов ГЭ-КП в различных соответствующих органах технических комиссий ВМО, а также усиление поддержки со стороны Секретариата и расширение деятельности по связям и коммуникации.

Нагрузку на кадровые ресурсы Секретариата можно ограничить за счет прикомандирования Членами ВМО экспертов в дополнение к персоналу Секретариата, а также за счет использования возможность проведения внешних консультаций. Исходя из этого предположения, расчетный годовой объем финансовых ресурсов, необходимых для финансирования деятельности в рамках настоящего четырехлетнего плана, составляет 220 000 шв. фр.

Статья расхода	Годовая стоимость (швейцарские франки)
Участие квалифицированных экспертов в одном ежегодном совещании ГЭ-КП и соответствующих целевых групп	40 000
Участие членов ГЭ-КП в работе соответствующих органов технических комиссий ВМО	30 000
Взаимодействие с внешними партнерами	20 000
Информационные мероприятия, разработка или перевод учебных материалов	20 000

Статья расхода	Годовая стоимость (швейцарские франки)
Учебные мероприятия и практические семинары	50 000
Консультации и финансовая поддержка прикомандирования персонала в Секретариат	60 000
Всего	220 000

Таблица 1. Предварительный расчет годового объема ресурсов, необходимых для поддержки настоящего плана

В соответствии с планом регулярного бюджета на девятнадцатый финансовый период предполагается, что не связанные с персоналом ресурсы, выделяемые из регулярного бюджета на деятельность, связанную с космической погодой, будут по-прежнему предельно ограничены, и необходимо будет задействовать внебюджетные ресурсы, включая:

- вклады стран-членов в натуральной форме (например, перевод учебных материалов, прикомандирование персонала или участие в совещаниях без каких-либо затрат со стороны ВМО);
- совместное спонсирование мероприятий (например, учебные семинары при поддержке КОСПАР);
- добровольные взносы в Целевой фонд для координации деятельности в области космической погоды.

Предварительные сведения о годовом объеме ресурсов	Швейцарские франки
Регулярный бюджет	40 000
Добровольные взносы в Целевой фонд для координации деятельности в области космической погоды	180 000
Всего	220 000

Таблица 2. Предварительное распределение ресурсов

В таблице 2 представлено предварительное распределение годового объема ресурсов. Ожидается, что Члены ВМО, осуществляющие национальные программы в области космической погоды, например, в рамках МКСК, будут более заинтересованы делать взносы в Целевой фонд для координации деятельности в области космической погоды с целью получения выгоды от повышения эффективности их деятельности на национальном уровне посредством обмена данными, передовыми практиками и оптимизации усилий, которая может значительно превысить индивидуальные вклады этих Членов.

ЗАКЛЮЧЕНИЯ

Первые результаты деятельности МКГКП в течение шестнадцатого финансового периода (2012—2015 гг.), а также последующие достижения МПГ-ИСОКП в течение семнадцатого периода (2016—2019 гг.), которые перешли в ведение ЭГ-КП в 2022 году, указывают на широкий спектр видов деятельности, которым может принести пользу участие ВМО в деятельности, связанной с космической погодой, и демонстрируют способность ВМО эффективно содействовать достижению прорыва в этой области и играть общепризнанную роль в международном сообществе, занимающемся вопросами космической погоды. Учитывая установленные требования к обслуживанию информацией о космической погоде в

авиации, а также растущий спрос со стороны других секторов, рекомендуется, чтобы в течение девятнадцатого финансового периода (2024—2027 гг.) и в последующий период ВМО продолжала участвовать и расширять свое участие в этой деятельности в целях создания устойчивой основы для предоставления глобального и надежного обслуживания в области космической погоды.

В настоящем плане приведен перечень высокоприоритетных видов деятельности, которые представляется необходимым и целесообразным осуществить в течение четырех лет и которые дадут четкие промежуточные и реальные конечные результаты. В плане также определены другие желаемые виды деятельности, которые должны быть реализованы при наличии соответствующего времени и ресурсов. Кроме того, предлагается, чтобы Члены ВМО, находящиеся на передовом уровне развития в этой области, подключились на техническом уровне за счет участия их экспертов, а также на финансовом уровне посредством внесения небольших взносов в Целевой фонд для координации деятельности в области космической погоды, чтобы занять ведущую позицию в реализации плана, тем самым демонстрируя выгоды от этой деятельности другим Членам, которые, возможно, еще не осведомлены о космической погоде.

Предлагаемые виды деятельности соответствуют нескольким стратегическим приоритетам ВМО на девятнадцатый период, охватывающим инфраструктурные компоненты ИГСНВ, ИСВ и КСОПВ (задачи 2.1, 2.2 и 2.3 соответственно) и способствующим расширению обслуживания в области наукастинга и прогнозирования (задачи 1.1 и 1.4 соответственно).

ПРИЛОЖЕНИЕ 5. СПИСОК УЧАСТНИКОВ

(только на английском языке)

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