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| WEATHER CLIMATE WATER | **World Meteorological Organization**  **COMMISSION FOR OBSERVATION, INFRASTRUCTURE AND INFORMATION SYSTEMS**  **First Session** 9 to 13 November 2020, Virtual Session | **INFCOM-1/Doc. 4.1.1(1)** |
| Submitted by: Chair  10.XI.2020  **APPROVED** |

**AGENDA ITEM 4: TECHNICAL REGULATIONS AND OTHER TECHNICAL DECISIONS**

**AGENDA ITEM 4.1: Decisions requiring approval by the Infrastructure Commission at this Virtual Session**

***AGENDA ITEM 4.1.1: Standing Committee on Earth Observing Systems and Monitoring Networks (SC-ON)***

# PLAN FOR THE WIGOS INITIAL OPERATIONAL PHASE (2020-2023)

**DRAFT RECOMMENDATION**

**Draft Recommendation 4.1.1(1)/1 (INFCOM-1)**

**Plan for the WIGOS Initial Operational Phase (2020-2023)**

THE COMMISSION FOR OBSERVATION, INFRASTRUCTURE AND INFORMATION SYSTEMS,

**Recalling** [Resolution 1 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.Xl414qhKhPY) - WMO Strategic Plan, [Resolution 37 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.Xl414qhKhPY) - the WMO Integrated Global Observing System transition to operational status commencing in 2020, [Resolution 38 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.Xl414qhKhPY) - Vision for the WMO Integrated Global Observing System in 2040, [Resolution 47 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.X2hrmmgzaPN) - Ocean observations in support of Earth system prediction and WMO support to the Global Ocean Observing System Strategy 2030 (including the Tropical Pacific Observing System 2020), and [Resolution 50 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.Xl414qhKhPY) - Pre-operational Phase of the Global Cryosphere Watch,

**Recalling** the essential role of observations as one of the foundations upon which all products and services provided by WMO Members to their constituencies in the areas of weather, climate and water are built,

**Noting** that the *WMO Strategic Plan for 2020-2023* ([WMO-No. 1225](https://library.wmo.int/index.php?lvl=notice_display&id=21525#.Xl5am6hKhPY)) clearly defines as its long-term Goal 2 to “Enhance Earth system observations and predictions: Strengthening the technical foundation for the future”,

**Noting further** that Global Earth system observations will provide a basis for meeting the demand for increasingly seamless prediction capability from nowcast weather to climate scales based on a unified modelling approach,

**Having examined** the draft Plan for the WIGOS Initial Operational Phase (2020-2023) provided in the [annex](#Annex_Draft_Resolution) to the draft Resolution X/X (EC-73),

**Endorses** the current draft Plan for the WIGOS Initial Operational Phase (2020-2023) (hereafter/ thereafter referred to as “Plan”) as provided in the [annex](#Annex_draft_rec) to the present recommendation;

**Invites** technical commissions and regional associations to contribute to the finalization of the draft Plan as appropriate;

**Invites** international partner organizations to provide their feedback as needed;

**Requests** the Secretary-General to take the necessary steps to finalize the draft Plan for its submission to EC-73;

**Requests** further the Secretary-General to determine the best way to support the NMHSs in implementing the WIGOS principles and involving their various national providers of observational data and to provide assistance to Members in promoting the principles of WIGOS and the benefits of partnership at a national level.

**Recommends** to the Executive Council to approve the draft resolution as provided in the [annex](#Annex_draft_rec) to the present recommendation;

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[Annex: 1](#Annex_draft_rec)

**Annex to draft Recommendation 4.1.1(1)/1 (INFCOM-1)**

**Draft Resolution X/X (EC-73)**

**Plan for the WIGOS Initial Operational Phase (2020-2023)**

THE EXECUTIVE COUNCIL,

**Recalling** [Resolution 1 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.Xl414qhKhPY) - WMO Strategic Plan, [Resolution 37 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.Xl414qhKhPY) - the WMO Integrated Global Observing System transition to operational status commencing in 2020, [Resolution 38 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.Xl414qhKhPY) - Vision for the WMO Integrated Global Observing System in 2040, [Resolution 47 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.X2hrmmgzaPN) - Ocean observations in support of Earth system prediction and WMO support to the Global Ocean Observing System Strategy 2030 (including the Tropical Pacific Observing System 2020), and [Resolution 50 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.Xl414qhKhPY) - Pre-operational Phase of the Global Cryosphere Watch,

**Noting** Recommendation 4.1.1(1)/1 (INFCOM-1);

**Adopts** the Plan for the WIGOS Initial Operational Phase (2020-2023), as contained in the [annex](#Annex_Draft_Resolution) to the present resolution[[1]](#footnote-2);

**Requests** Members, regional associations and technical commissions to organize their activities to realize WIGOS goals and associated outcomes as described in the Plan;

**Requests further** Members to continue to provide resources, including through the WIGOS Trust Fund and/or seconded experts, to help support the implementation of WIGOS;

**Requests** the Commission for Observation, Infrastructure and Information Systems (INFCOM), to provide the technical lead in WIGOS operational activities;

**Requests further** INFCOM to keep the Plan under regular review, to update, and report progress in the implementation of the Plan to the Executive Council, and to submit a report to the Nineteenth World Meteorological Congress;

**Requests** the Secretary-General:

(1) To provide the necessary assistance and Secretariat support to Members and regional associations, especially to developing and least developed countries, for the further development of WIGOS through its operational phase, within available resources;

(2) To consider allocating resources from the regular budget for the continued development of the WIGOS technical tools;

(3) To motivate Members to contribute the necessary resources for the further development of the WIGOS technical tools;

(4) To initiate a long-term planning – including the necessary allocation of resources – for the development of WIGOS tools in all WMO official languages, and for the operational sustainability of these tools;

**Invites** partners to participate in relevant implementation activities as specified in the Plan.

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Note: This resolution replaces Resolution 2 (EC-68) which is no longer in force.

**Annex to draft Resolution X/X (EC-73)**

**WORLD METEOROLOGICAL ORGANIZATION**

**WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)**

**THE PLAN FOR THE WIGOS INITIAL OPERATIONAL PHASE (2020-2023)**

(Ver. 30.09.2020)



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**EXECUTIVE SUMMARY**

This document describes the objectives and main planned activities for the initial part of the WIGOS operational phase, beginning with the eighteenth WMO financial period (2020-2023). The Plan was developed in accordance with [Resolution 37 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.X5l_Voj0kgw) - the WMO Integrated Global Observing System transition to operational status commencing in 2020, and [Resolution 38 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.X5l_Voj0kgw) - Vision for the WMO Integrated Global Observing System in 2040.

The document outlines the initial operational capabilities of WIGOS to be in place by 2020, and it describes the main activities that are planned to take place from 2020 and beyond in order to further develop the system during this next period. The activities are structured in six main priority areas, namely:

(1) National WIGOS implementation, including necessary capacity development, partnership agreements and integration of observing systems for all application areas;

(2) Fostering a culture of compliance with the WIGOS technical regulations;

(3) Implementation of the Global Basic Observing Network and the Regional Basic Observing Networks;

(4) Operational deployment of the WIGOS Data Quality Monitoring System;

(5) Operational implementation of regional WIGOS centres;

(6) Further development of the Observing Systems Capability Analysis and Review (OSCAR) databases.

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**1. INTRODUCTION**

Aligned with the [*WMO Strategic Plan 2020-2023* (WMO-No. 1225)](https://library.wmo.int/doc_num.php?explnum_id=9939), Objective 2.1 - Optimize the acquisition of Earth system observation data through the WMO Integrated Global Observing System (WIGOS), this Plan responds to Resolution 37 (Cg-18) - the WMO Integrated Global Observing System transition to operational status commencing in 2020, and Resolution 38 (Cg-18) - Vision for the WMO Integrated Global Observing System in 2040.

The Plan takes into account the six priority areas decided by Congress, and brings focus on the WMO Earth system approach, and how to integrate observations from all Earth system domains in order to serve WMO Application Areas[[2]](#footnote-3) and allow WMO Members to deliver services according to the WMO mandate and in the most efficient way.

With an Earth system perspective, WIGOS is designed to manage observations from a diversity of surface- and space-based observing systems, provided by a diversity of observations contributors. These observations are acquired by a variety of players with the aim of providing an integrated, composite set of observations accessible to many users and are suitable for many service and science applications.

**2. CURRENT STATUS OF WIGOS**

By the end of the WIGOS pre-operational phase in December 2019, the status of WIGOS can be summarized as follows:

**2.1 National WIGOS Implementation**

Almost all Members have had exposure to both the WIGOS concept and to the specifics of the WIGOS technical systems via a dedicated WIGOS workshop arranged by the WMO Secretariat in all regions. A majority of Members have had at least some level of activity in using the OSCAR/Surface[[3]](#footnote-4) database to manage their surface-based observing systems. A small number of countries have developed and approved their National WIGOS Implementation Plans. The bulk of the national WIGOS implementation work is expected to take place once the regional WIGOS centres are fully functional and once national WIGOS implementation plans have been developed and approved.

WIGOS encourages and enables the integration of observations from different national observations providers, 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.

See [5.1](#National) for how national WIGOS implementation is being addressed as part of the Plan; and <https://community.wmo.int/implementation-examples>.

**2.2 WIGOS Regulatory and Guidance Material**

The [*Manual on the WMO Integrated Global Observing System* (WMO-No. 1160)](https://library.wmo.int/index.php?lvl=notice_display&id=19223) has undergone revision, in particular as concerns the WIGOS Metadata Standard and the description of the Global Cryosphere Watch (GCW). It has been expanded very significantly with new provisions describing a series of Regional Basic Observing Networks serving a large number of application areas at the global, regional and sub-regional levels, and an overarching Global Basic Observing Network to specifically serve Global Numerical Weather Prediction (NWP) and climate analysis. A draft amendment to the manual, specifically on the GBON and WSIs provisions, is being developed.

A [*Guide to the WMO Integrated Global Observing System* (WMO-No. 1165)](https://library.wmo.int/index.php?lvl=notice_display&id=20026#.Xl5fqqhKhPY) has been developed and is being continually expanded with new material. A draft update of the guide supporting implementation of GBON and WSIs provisions is being developed.

**2.3 Observing Systems Capabilities and Review (OSCAR) databases**

The OSCAR/Requirements[[4]](#footnote-5) database has been amended and updated to include all 14 currently recognized application areas. Work towards completing and updating the actual observational user requirements in the database is ongoing.

The OSCAR/Space database (Version 2.0) has been deployed and is widely used by space agencies and the user community.

The OSCAR/Surface database was operationally deployed in 2016, replacing Volume A ([WMO‑No. 9](https://library.wmo.int/index.php?lvl=notice_display&id=6870#.Xl5gCqhKhPY)), while offering much more extensive metadata information for many more stations than those included in Volume A.

The databases can be accessed via <https://oscar.wmo.int>.

A strategy for the longer-term evolution of the OSCAR platform and for maintaining both the IT infrastructure and the information content has been developed and needs to be implemented ([see 5.6](#further) below).

**2.4 WIGOS Data Quality Monitoring System**

The concept for the overarching WIGOS Data Quality Monitoring System (WDQMS) is relatively mature. A pilot project using the existing monitoring capabilities of the global NWP Centres for the surface component of the Global Observing System is being transitioned to pre-operational status and has already demonstrated the value of such a system.

See [5.4](#WDQMS_5_4) for how WDQMS will evolve as part of the Plan.

The WDQMS webtool was launched in its first operational release on 17 March 2020 (the pre-operational release had been published on 3 December 2019). Since then, the WDQMS webtool has been evolving with new releases, 1.1 launched in April 2020 and 1.2 launched in July 2020, providing additional functionalities. It is expected that the GCOS monitoring results, related to the surface and upper-air climate observing networks, will be integrated into the WDQMS webtool before the end of 2020. The integration of other WIGOS observing components will be discussed and implemented progressively.

**2.5 Regional WIGOS centres**

**Region I:** In early2020, Kenya and Tanzania established a network of two RWC nodes with pilot mode operations progressively in place. They cover the East African countries’ sub-region, splitting the mandatory functions between the two countries. In addition, South Africa has been working on establishing a single RWC for the South African Development Community (SADC) countries; and Morocco has expressed interest in establishing a RWC for West Africa, and possibly for some more countries.

**Region II:** Regional WIGOS centres in pilot mode for the region have been established by China and Japan, with the coordination of operations between the two countries being under discussion. Other Members have expressed their interest in establishing RWCs in RA II, such as Saudi Arabia for the Gulf Cooperation Council (GCC) countries, Russia for the Russian speaking countries and India.

**Region III:** A virtual Regional WIGOS Centre was approved by RA III-17, with distributed functions involving two Members, Brazil and Argentina, and a coordination committee. This RWC has progressively started since early 2020.

**Region IV:** In early 2020, the management group supported the development of a concept for establishing a network of RWC nodes in the region. Follow-up discussions are ongoing, involving various Members and organizations of the region (the United States of America, Canada, Costa Rica, Trinidad & Tobago and the Caribbean Meteorological Organization) in order to agree on how to split the functions and responsibilities and how to develop an RWC implementation plan for RA IV.

**Region V:** A concept for a distributed regional WIGOS centre for RA V was decided by RA V-17 session. Discussions are ongoing, involving Indonesia, Singapore and Fiji (Members that have submitted individual applications), and Australia that has expressed interest in participating, towards establishing a network of RWC nodes, and to agree on how to split the functions and responsibilities, as well as on an implementation plan.

**Region VI:** A regional WIGOS centre in pilot mode, based on the EUMETNET infrastructure (Germany, UK), was approved by the RA VI session, with partial functionality for the region. Discussions are needed with other interested Members of RA VI (Russia, Turkey, Italy, Croatia) to plan and agree on how to establish additional RWC nodes in order to fully perform the mandatory functions covering the whole region.

The establishing of RWCs in Antarctica is at an early stage, with some informal discussions taking place.

See [5.5](#Operational_5_5) for how the network of RWCs will be developed as part of the Plan.

**2.6 The Vision for WIGOS in 2040**

Congress adopted the Vision for WIGOS in 2040 through Resolution 38 (Cg-18). The vision presents a likely scenario of how user requirements for observational data may evolve over the next 20 years, and an ambitious, but technically and economically feasible vision for an integrated observing system that will meet them.

It provides high-level targets to guide the evolution of WIGOS in the coming decades. It anticipates a fully developed and implemented WIGOS framework that supports all activities of WMO and its Members within the general areas of weather, climate, water, and other related environmental applications.

The vision is available on the WMO Website at: <https://community.wmo.int/vision2040>

See [5.7](#Evolution_5_7) for the response to Vision for WIGOS in 2040 during the period 2020-2023 as part of the Plan.

**3.** **WIGOS Priority areas for the 2020-2023 Financial Period**

The Plan was developed in accordance with Resolution 37 (Cg-18) - the WMO Integrated Global Observing System transition to operational status commencing in 2020, and Resolution 38 (Cg-18) - Vision for the WMO Integrated Global Observing System in 2040.

This Plan guides the development and initial operation of WIGOS over the coming four years on global and regional levels; it sets priorities and defines targets and serves as a reference for Members in the development of their National WIGOS Implementation Plans.

Thanks to the development activities undertaken during the pre-operational phase (2016-2019), WIGOS has now matured to a level where it is ready to enter its initial operational phase commencing in 2020. However, there are significant remaining capability gaps, including ocean observations, and other challenges that will need to be addressed during the next phase of WIGOS in order for the system to fully serve all WMO application areas and help Members exploit the full potential of partnership agreements.

The development of WIGOS will thus need to continue during the eighteenth financial period (2020-2023), building upon and adding to the capabilities developed during the pre-operational phase.

The highest priorities for WIGOS during this period are:

(1) National WIGOS implementation, including necessary capacity development, partnership agreements and integration of observing systems for all application areas;

(2) Fostering a culture of compliance with the WIGOS technical regulations;

(3) Implementation of the Global Basic Observing Network and the Regional Basic Observing Networks;

(4) Operational deployment of the WIGOS Data Quality Monitoring System;

(5) Operational implementation of regional WIGOS centres;

(6) Further development of the OSCAR databases.

High priority will be given to those activities that will assist Members in developing and implementing their National WIGOS Implementation Plans, with special emphasis on least developed countries, landlocked developing countries and small island developing states where the needs are highest.

An important underlying issue is 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 lifecycle management of data, to ensure that Members are able to manage their observations and data efficiently and effectively, to extract the value from the data in support of their services, and to integrate observations and data from diverse platforms and from external sources (e.g. the academic community, the private sector and third parties).

Central guidance provided by the Infrastructure Commission and support provided by the WMO Secretariat will be important. During the WIGOS operational phase, NMHSs, working with national partners, are expected to take on greater responsibility for the national implementation of WIGOS and 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. The NMHSs are thus expected to become the key players at the national level, both by strengthening their own observing systems in accordance with the *WMO Technical Regulations* (WMO-No. 49), 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.

**4. KEY DELIVERABLES AND OUTCOMES**

The work to be undertaken during the eighteenth financial period (2020-2023) is driven by (i) the desire to fully develop the key WIGOS networks, namely the Global Basic Observing Network (GBON) and the Regional Basic Observing Networks (RBONs), (ii) the need to further mature the technical tools so that WIGOS can support all official WMO application areas, and (iii) the need to strengthen national WIGOS implementation and associated regional support mechanisms.

The projected status of WIGOS at the end of the eighteenth WMO financial period in 2023 can be described via the following two elements:

***Expected deliverables***: Which elements must be completed, and what are the necessary operational functionalities; and

***Expected outcomes***: What is the expected impact of WIGOS, and in particular, what are the expected benefits to WMO Members?

**4.1 Expected Deliverables**

By the end of the 2020-2023 financial period, the WIGOS framework at global, regional, and national levels will have been completed, encompassing:

 Response to Vision for WIGOS in 2040: Progressive evolution of global observing systems in response to the Vision for WIGOS in 2040, taking into account evolving or emerging user requirements, technology, priorities and aligned with WMO’s Earth system approach and requirements for Earth system monitoring and the seamless GDPFS;

 The GBON will have been implemented;

 The RBON will have been implemented in all regions;

 The GCOS Surface Network (GSN), the GCOS Upper Air-network (GUAN) and the GCOS Reference Upper-air Network (GRUAN) will continue operations and will provide enhanced support and guidance to the GBON and RBON, through the tiered network concept;

 A pilot GCOS Surface Reference Network (GSRN) will provide the surface reference component of the tiered network design of WIGOS;

 The observing component of the Global Cryosphere Watch will be fully integrated in WIGOS, with surface stations registered in OSCAR, operating according to WIGOS standards and regulatory materials, with adequate compliance verification, and an integrated approach to cryosphere observing requirements;

 Ocean observing systems will be integrated in WIGOS, starting with those GOOS Essential Ocean Variables (EOVs) addressing high-impact weather NWP requirements, in accordance with the GOOS Implementation Strategy 2030, related GOOS Implementation Roadmap and the Framework for Ocean Observing (FOO).

 Standards for observational data assimilation into Earth system models, including coupled ocean data assimilation (ODA), will have been established and adopted by a substantial majority of members;

 Regional WIGOS centres will have been established and functional in each region, and all Members will have affiliated with one RWC;

 National WIGOS Implementation Plans will have been adopted/approved by a substantial majority**[[5]](#footnote-6)** of WMO Members;

 National WIGOS governance mechanism will have been established by a substantial majority of Members;

 National WIGOS partnership agreements for integration and open sharing of observations across all WIGOS component observing systems (WMO and partners) will have been implemented and used by the substantial majority of Members;

 WIGOS Station Identifiers: technical issues resolved and new system adopted; policy for issuing IDs defined, adopted and implemented by Members and accredited partners;

 Climate requirements and needs identified by GCOS integrated into WIGOS regulatory material and RRR processes;

 The WIGOS Data Quality Monitoring System (WDQMS) will be fully operational for all essential real-time components of the Global Observing System (GOS) and for delayed mode climate components of the GOS identified by GCOS; national processes for acting on issues and incidents received from the WDQMS will be in place; the WDQMS will have at least functioning pilots for various WIGOS components;

 All components (databases) of the Observing Systems Capability Analysis and Review (OSCAR) platform will befully operational and updated; a substantial majority of Members will be actively maintaining their metadata in the system; a gap analysis support tool or function will have been implemented;

 The process to capture historical metadata for various WIGOS components will be in place, with functioning pilots across a range of ECVs;

 The WMO-IATA Collaborative AMDAR Programme will have been established at the global and regional levels, including the regional and global centres that support its operation.

**4.2 ExpectedOutcomes**

From the activities detailed in this Plan, the following outcomes are expected:

 Enhanced WIGOS delivering observations to support all WMO priorities, programmes and application areas with guidance provided to Members on how to evolve their observing systems in response to the Vision for WIGOS in 2040;

 Enhanced real-time provision and delivery of essential observations from all relevant domains, to meet the prescribed requirements of operational global Earth system modelling;

 Increased visibility and strengthened role of NMHSs, as a partner, enabler and integrator of observations, at their national level;

 Increased integration and open 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;

 Enhanced capabilities to identify and address gaps in global, regional, sub-regional, and national observing systems in the context of user needs, issues, etc.;

 Enhanced cooperation with partners at the national and regional levels;

 Improved global coverage of the GCW surface observing component, within the framework of WIGOS;

 Enhanced compliance with *WMO Technical Regulations* (WMO-No. 49);

 Enhanced human, institutional and technical capacities of all WMO Members for planning, implementation and operation of WIGOS;

 Improved availability and quality of WIGOS observational data and metadata;

 An enhanced and expanding Aircraft Meteorological Data Relay (AMDAR) observing system supporting the RBON and GBON.

**5. ACTIVITIES**

A number of specific activities supporting the milestones laid out within the six proposed priority areas of the WIGOS operational phase listed in [section 3](#Priority_3) are being planned for the 2020-2023 period.

**5.1 National WIGOS implementation**

Special priority will be given to activities that will help Members in assessing the capability of their observing systems and networks to provide, in a sustainable way, essential surface-based observational data that meet WMO standards, including international data sharing, and to identify gaps in the context of users’ needs and requirements; assessing their compliance with the standards listed in the *Technical Regulations* ([WMO-No. 49)](https://library.wmo.int/index.php?lvl=notice_display&id=14073), Volume I, Part I, and in the *Manual on the WMO Integrated Global Observing System* [(WMO-No. 1160)](https://library.wmo.int/index.php?lvl=notice_display&id=19223); and logically, assistance in developing a project to implement WIGOS at the national level.

A special focus will be given to least developed countries, landlocked developing countries and small island developing states where the needs are highest. High priority will be further given to strengthening the capacity of these countries, through the provision of guidance on best practices and procedures in the area of integration of automatic weather stations in their observing networks. [See also 10.3](#National_level_10_3).

NMHSs, as an enabler and integrator of observations at their national level, will reach out with their national partners, such as other governmental and non-governmental organizations, research institutes, volunteer networks, 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. See [section 7](#Partnerships_7) for details.

**5.2 F****ostering a culture of compliance with the WIGOS technical regulations**

Members’ compliance with WIGOS technical regulations listed above in [5.1](#WIGOS_implementation_5_1) will be mainly assessed via the WIGOS readiness indicators and criteria that will be reviewed and further developed building on those initially approved by [Decision 31 (EC-69)](https://library.wmo.int/index.php?lvl=notice_display&id=19919#.X5rfkIj0kgw) - Indicators for monitoring progress in the WMO Integrated Global Observing System national implementation, for which an online tool has been developed and provides results for specific dates, e.g. for 1 June 2019, results are available on the website[[6]](#footnote-7). Those indicators and criteria will then be updated to allow an improved and more realistic assessment of Members’ compliance with WIGOS implementation and with other WIGOS standards and recommendations. This process relates to [5.1](#WIGOS_implementation_5_1), as it will measure the progress of national WIGOS implementation.

To enable having an operational WIGOS readiness tool, results must be provided by various other supporting tools, mainly the WIGOS Data Quality Monitoring System (WDQMS) webtool ([5.4](#deployment)) and the OSCAR databases ([5.6](#further)). The reports and statistics that will be provided by the regional WIGOS centres (RWCs) once they are established, should also be taken into account as input for the assessment of Members’ compliance with WIGOS technical regulations, particularly as regards the availability and quality of data (mostly that in near-real time) and metadata (in OSCAR/Surface).

Relevant WIGOS-related (regional/global) centres will be identified and a framework will be developed to assess their performances against their WMO mandate(s). See also [5.4](#deployment) and [5.5](#Operational).

**5.3 Implementation of the Global Basic Observing Network and the Regional Basic Observing Networks**

Through Resolution 34 (Cg-18), Congress adopted the overall concept for the Global Basic Observing Network (GBON), as provided in the annex to the resolution; the concept defines the obligation of WMO Members to implement a minimal set of surface-based observing stations for which international exchange of observational data will be mandatory in support of global Numerical Weather Prediction (NWP) and climate analysis.

Congress requested the Infrastructure Commission (INFCOM) to draft relevant provisions of the [*Manual on the WMO Integrated Global Observing System* (WMO-No. 1160)](https://library.wmo.int/index.php?lvl=notice_display&id=19223) regarding the implementation of the GBON and to submit these to EC-72 for approval. Congress further requested INFCOM to: (i) develop a proposal for a process for nomination, review and approval of the composition of the GBON and submit it to EC-72 for approval, with the overall aim of having the initial composition of GBON approved by Cg-Ext.(2021); and (ii) establish a consultative process to assist Members and relevant international organizations and programmes with the implementation of the GBON.

In response to GBON obligations, each WMO Member will have to develop and implement a GBON national contribution. Technical support will be provided by INFCOM and the WMO Secretariat.

Regional associations will have to develop a plan for a phased GBON implementation, taking into account the unique circumstances and capabilities of the individual WMO Members. Engagement of international organizations (e.g. IOC of UNESCO for the GBON expansion into the ocean) and programmes in the implementation of the GBON will be critical. The Systematic Observations Financing Facility will support developing countries in defining, achieving and sustaining their GBON national contribution with the initial target to achieve developing countries’ GBON compliance by 2025.

**5.4 Operational** **deployment of the WIGOS Data Quality Monitoring System**

As the WIGOS Data Quality Monitoring System (WDQMS) concept consists of three functions, the monitoring function, the evaluation function and the incident management function, the need for online tools to support these functions have been recognized, for the use of Members and of RWCs ([see 5.5](#Operational)).

For the monitoring function, a WDQMS webtool has been developed, initially providing results based on four global NWP centres for the land stations of the Global Observing System (GOS) - on 3 December 2019 a pre-operational version of the WDQMS webtool was released (<https://wdqms.wmo.int/>). The activities for 2020-2023 related to this webtool should be on further developing it and making it fully operational and used by RWCs, as well as on expanding it to allow integration of other observing systems of the GOS (for example marine and aircraft observations) and also the integration of other WIGOS observing components, i.e. the observing component of the Global Atmosphere Watch (GAW), the WMO Hydrological Observing System (WHOS), and the observing component of the Global Cryosphere Watch (GCW) and consideration of co-sponsored observing systems (Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS). This will require deep technical discussions with the various communities in order to map their activities against the WDQMS concept and to identify whether and how they would be integrated in the WDQMS webtool.

For the incident management function a global tool is also needed and a test has been started using the ECMWF incident management system software. A prototype of such system should be made available to RWCs for testing and for using in their pilot mode operations from 2020. From 2021, the prototype should be converted into a global operational tool for all RWCs and Members, where issues and incidents are registered and tracked down.

**5.5 Oper****ational i****mplementation of regional WIGOS centres**

Coordination of the RWC pilots should be provided centrally by the Secretariat. For such coordination activities, regional/sub-regional workshops will continue to be organized, with the engagement of the WMO regional structures/offices, in order to further develop and agree on their concepts and detailed plans taking into account the specifics of each region/sub-region (language, geography, etc.) that may impact on the implementation and operations of the RWCs. The activities towards the implementation of RWCs will also include further development and the provision of technical guidance as well as support, such as training (see section 6 - Capacity Development), to the Members that are establishing RWCs; It will also include making the reference tools operationally available to RWCs – currently, these are the WDQMS webtool, the OSCAR/Surface ([5.6](#_5.6__Further)) and the incident management tool ([5.4](#deployment)). An assessment process for RWCs will have to be developed and applied to certify those RWCs that will become operational centres. For most RWCs this will happen at a later stage of the WIGOS operational phase, after running in pilot mode for 1-2 years.

A virtual forum on RWCs will be organized for regular online discussions on common issues and sharing of experiences/lessons learned, amongst RWCs across all regions and sub-regions.

A discussion, possibly including a dedicated workshop, with the various WIGOS communities will be started in order to review the current RWCs scope towards expanding the concept, to allow integration of other observing systems and/or functions of other WIGOS-related centres, such as the regional instrument centres, the lead centres for GCOS and other monitoring centres, the AMDAR data centres, etc.

**5.6** **Further development of the Observing Systems Capability Analysis and Review (OSCAR) databases**

The OSCAR Platform Strategy 2020-2023 was developed in 2019 in consultation with key stakeholders. The strategy is based on a holistic approach and focusses on the [observational user requirements](https://www.wmo-sat.info/oscar/observingrequirements) and WIGOS metadata requirements of all WMO application areas.

The strategy offers the following vision: An operational, sustainable, efficient, evolving, usable and practical Global Information System for WIGOS in 2023, providing a comprehensive and trusted perspective on observational user requirements of WMO application areas, in particular those for Earth system prediction, as well as on surface- and space-based observing systems capabilities, interfaced with relevant WIGOS data quality monitoring information.

A summary of the strategy is available in [INFCOM-1/INF. 4.1.1(1)](https://meetings.wmo.int/INFCOM-1/_layouts/15/WopiFrame.aspx?sourcedoc=/INFCOM-1/InformationDocuments/INFCOM-1-INF04-1-1(1)-PLAN-WIGOS-INITIAL-OPERATIONAL-PHASE_en.docx&action=default).

**5.7** **Evolution of observing systems in response to the Vision for WIGOS in 2040**

In light of the WMO Strategic Plan 2020-2023, and in particular Strategic Objective 2.1, Resolution 37 (Cg-18) and Resolution 38 (Cg-18), there will be the need to develop planning activities for the financial period 2020-2023 in response to the Vision for WIGOS in 2040, and distribute the collaborative roles regarding (i) the work to be done by the WMO working structures (essentially the Infrastructure Commission, and the regional associations) and the Secretariat, and (ii) the required actions by Members.

The following key considerations will be made to plan the WMO response to the Vision for WIGOS in 2040:

 Promote and highlight the WMO’s Earth system approach;

 Have an integrated approach[[7]](#footnote-8) (see also section 8), and promote synergies across all WIGOS component observing systems;

 Evolve WMO *Technical Regulations* (WMO-No. 49) and guidance material in line with evolving requirements and gaps;

 Promote a culture of compliance (see also [5.2](#fostering));

 Align the evolution of WIGOS with the evolution of WIS (see also [5.8](#wigo));

 Promote capacity development tools (see also [section 6](#Capacity_development));

 Focus on a number of priority areas where concrete and effective achievements or improvements of observing systems capabilities can be realized and progress demonstrated during the financial period;

 Recognize Members’ flexibility in ‘how’ they approach design, evolution and planning of their observing capabilities, using the Vision for WIGOS in 2040 as a driver; and

 Promote the central role of an integrated OSCAR (OSCAR/Requirements, OSCAR/Surface and OSCAR/Space) ([see 5.6](#further)).

In so doing, a guidance document for the evolution of global observing capabilities will be developed. The document will be simple and easy to use by all implementation agents, including the wide range of public and private institutions that contribute observations, and to monitor, and will provide a focus on some key priorities, while adopting a more dynamic approach allowing the implementation actions to be adjusted according to evolving requirements, technology, and opportunities. The guidance document will for example include a summary of the findings and recommendations from the series of international workshops on the impact of various observing systems on NWP, and a synthesis of key observational gaps from the Rolling Review of Requirements Statements of Guidance with some recommendations on how to address these gaps.

**5.8 Im****plementation of WIGOS Station Identifiers in the WMO Information System**

In accordance to Resolution 35 (Cg-18), a timetable for the implementation of WIGOS Station Identifiers has to be established taking into account the time needed by Members to modify their downstream systems to exchange, process and visualize data using WSI, especially data from new stations without a Traditional Station Identifier (TSI) as the initial priority. To achieve a fully operational exchange of data using the WSI the following areas need to be addressed:

(1) Procedure to assign WSI to new stations

Clear procedures are needed for the Members to be able to assign WSI to new stations. In this respect, each Member needs to develop a WSI national schema complying with *the Manual on the WMO Integrated Global Observing System* [(WMO-No. 1160)](https://library.wmo.int/index.php?lvl=notice_display&id=19223). To facilitate the process, the WMO Secretariat will provide some guidance material and sample schemas that can be adopted by Members.

(2) BUFR/CREX encoding with WSI

Encoding of BUFR/CREX messages have to follow the guidance provided in the circular letter [“Reporting of WIGOS Station identifier in BUFR/CREX messages”](https://www.wmo.int/edistrib_exped/grp_has/_en/Archives%202011_2017/2017/2017-10-30-OBS-WIS-DRMM-DRC-WIGOS-ID_en.pdf). Members are required to encode messages following that guidance, the B/C regulations and the BUFR/CREX regulations in the Manual on Codes Vol. I.2. GISCs have the role of facilitating the adoption of WSI initially for new stations without a TSI, by supporting national centres (NCs) in their area of responsibility in the encoding of WSI.

(3) GTS message-switching

GTS message-switching operated by NCs, RTHs and GISCs has to be able to handle a mixture of messages having and not having the WSI. Guidance on how to compose bulletins from mixed WSI and non-WSI messages has to be provided. The GTS message-switching in all the WIS centres has to follow the guidance that will be provided.

(4) Adaptation of users’ and NWP software and systems

The ecosystem of users’ software designed to work with the TSI requires significant adaptations to be able to make use of the WSI schema. The transition from TSI to WSI is made gradually by the requirement to have the WSI in addition to the TSI in the BUFR messages. The presence of both TSI and WSI in the data allows legacy systems to work using the TSI without a need for changes. Similar considerations apply to NWP software and systems. The transition should be planned based on the careful assessment of requirements and progress in adaptation by all Members and operational centres concerned, including NWP centres.

The following milestones are proposed to complete the transition. Implementation of “Exchange WSI BUFR on GTS” (see C. below) is conditional (to a large extent) on the implementation of “Software to process WSI” (see D. below) due to the risk of losing data, that is currently being shared internationally, if the majority of NWP centres are not ready to use BUFR with WSI.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | A. Assign WSI | B. Encode WSI in BUFR | C. Exchange WSI BUFR on GTS | D. Software to process WSI |
| July 2021 | Most of the Members able to assign WSI | Some Members able to encode data with WSI for new stations without a TSI | Some Members exchange WSI data on GTS | Check software can work with WSI and TSI |
| December 2021 | All Members able to assign WSI |  |  |  |
| July 2022 |  | Most Members able to encode data with WSI for new stations without a TSI | Most Members exchange WSI data on GTS | NWP can use data with WSI for new stations without a TSI |
| December 2022 |  | All Members able to encode data with WSI for new stations without a TSI | All Members exchange WSI data on GTS |  |
| July 2024 |  |  |  | All software able to process WSI |

**6. CAPACITY DEVELOPMENT**

Capacity development (CD) will remain a critical activity area during the WIGOS operational phase, and regional and national needs in this area will be one of the main drivers of the expenditure of WMO resources during the 2020-2023 financial period.

It should be noted that it is difficult to distinguish between specific CD efforts and WIGOS as a whole, since a majority of WIGOS activities (development of guidance material, training, support through RWCs) are in effect capacity development efforts.

The overarching goal of the WIGOS CD effort is to help equip Members with the requisite understanding, skills, information and knowledge to enable them to implement WIGOS at a national level, including the development of partnerships at the national level. This will be supported both through the development of guidance material and via the outreach efforts outlined in [section 9](#CommunicationsOutreach).

Close collaboration with international, regional and sub-regional development organizations (e.g. the World Bank, the Global Environment Facility, the Asian Development Bank) is needed in order to ensure that donors will benefit from and provide benefit to WIGOS. In particular, WMO will make use of new instruments such as the Country Support Initiative (CSI) and the Systematic Observations Financing Facility (SOFF), a new mechanism for financing the GBON implementation in SIDS and LDCs.

The GCOS cooperation mechanism will continue to support the NMHSs of developing countries on operational issues, specifically for GSN and GUAN nominated stations.

Regarding the ocean, support for implementation of the roadmap for the implementation of the GOOS 2030 Strategy for an open planning process, together with appropriate developments under the United Nations Decade of the Ocean for Sustainable Development, and engagement of WMO and its regional associations with the GOOS regional alliances, will be required. The Partnership for new GEOSS Applications (PANGEA), a concept developed by the former Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), is being used to develop partnerships between developed and developing countries to realize the socio-economic benefits of ocean observing systems on global and regional scales.

The operational and efficient use of the following specific WIGOS technical tools will require further developing the learning material and organizing training events in the regions/sub-regions, taking into account the needs and requirements of RWCs:

 OSCAR/Surface = maintain and further develop the online course and tutorial videos, and continue to run regular webinars (especially focussing on community specific templates and on the machine-to-machine transfer of metadata);

 WDQMS webtool = further develop the online learning materials, develop an online course with tutorial videos, and initiate a series of webinars (in close cooperation with WIS), especially focusing on issues related to data availability, quality and timeliness;

 WDQMS incident management tool = develop initial learning materials as well as dedicated webinars, to support the operational implementation of RWCs.

User manuals for each of the above tools will be developed and regularly updated and published in all WMO languages.

Also, the implementation of the WIGOS Station Identifiers ([5.8](#wigo)) will require further development of online learning materials, for each of the topics described in section 7, especially addressed to LDCs, LLDCs and SIDS.

Additionally, and to complement the training efforts regarding the national WIGOS implementation, more guidance and support will be needed for Members to develop their national observing strategies and their National WIGOS Implementation Plans.

**7. PARTNE****RSHIPS**

The ultimate goal of WIGOS is to establish sustainable monitoring of the Earth system for developing required products and services for the benefit of populations, with a focus on climate, weather, ocean, cryosphere and hydrosphere. This goal can only be achieved with a collaborative effort at national and international levels, as no single entity will have the full capacity to deliver such complex observation systems. Hence, a partnership is required at three levels:

(1) At national level for WMO Members: all governmental (incl. at sub-national structures) organizations having an official mandate in Earth system monitoring, as well as academia and private sector operating monitoring systems, without forgetting citizen communities.

(2) At international level, other UN[[8]](#footnote-9) and non-UN organizations and major NGOs either as providers or users of measurements.

(3) At national and international level, related monitoring systems such as biodiversity and ecosystems.

WIGOS is new for most of the players, and there must be motivation to engage in a collaborative process and to make their data available, e.g. to NMHSs, to the national and international WMO community, etc. A key principle of successful and sustained partnerships is the recognition of mutual benefit.

The interests of operators vary widely depending on the type of organization and its needs; consequently, the motivations to share observational data nationally (e.g. with NMHSs) or internationally with WMO Members are also very diverse.

Partnerships within the framework of WIGOS would address:

 Observation gaps:

— Representativeness and timeliness of observations especially in high impact locations or observation-sparse regions,

— Additional parameters not traditionally observed by NMHSs (e.g., biodiversity, land cover, forest, etc.) but relevant in the context of Earth system observations and prediction,

 Scientific and service information requirements meeting specific needs,

Activities to facilitate the development of partnerships:

 Map the national landscape of institutions and data providers and their arrangements, by physical domains/components/interest/etc. (who should/could be involved),

 Engage potential partners and identify areas of mutual benefit (contribution to specific national/international agendas, cost efficiency, visibility, etc.): national/regional workshops or meetings of opportunity,

 Build awareness of benefits from partnerships within the framework of WIGOS, on Earth system observations at national/regional scale, demonstrating the value added/impact, present available WMO tools, e.g. develop/disseminate standards and guidelines of observing practices, on 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, data representation, access, and exchange standards (WIGOS Metadata Standard, OSCAR Surface, Data Quality Monitoring System, etc.),

 Develop WIGOS tools that are sufficiently user-friendly to be used by all partners,

 Address the ownership of the observational data and any constraints on their use and sharing, data quality, discoverability, issues on licensing of data for specific uses vs free and open data,

 Learn from potential partners about advances in the scientific/other communities regarding specific relevant topics (e.g. semantics and terminology initiatives, e.g. Polar Data Forum, Research Data Alliance, etc.),

 Develop a framework for engagement of partners to ensure formal recognition of their engagement (at national and/or international level); develop a charter of WIGOS partnerships (or similar).

 Build on the recommendations of the former JCOMM Observations Coordination Group (OCG) recorded in the October 2019 document, “*Identifying Future Connection between the Observations Coordination Group (OCG), WMO and GOOS, post-JCOMM*”, as well as the guidance of the WMO-IOC Joint Collaborative Board (JCB) (see *JCB WMO/IOC Observations Discussion Paper*).

Chapter 7 of the [*Guide to the WMO Integrated Global Observing System*](https://library.wmo.int/doc_num.php?explnum_id=10040)([WMO-No. 1165](https://library.wmo.int/index.php?lvl=notice_display&id=20026))regarding data partnerships is relevant in the context of engaging institutions to contribute to the goals of WIGOS.

The partnership with the International Air Transport Association, expected to be formalized with a new or updated working arrangement with WMO in 2020, will be instrumental in forming and developing the WMO-IATA Collaborative AMDAR Programme (WICAP) following Resolution 39, Cg-18. The Infrastructure Commission will provide oversight for the WICAP Implementation Plan, including the formation of the governing and legal frameworks and the establishment of the regional WICAP AMDAR programmes. IATA will play a key role in developing the business case for airline partner participation and assist in the technical aspects of airline implementation.

**8.** **INTEGRATION OF OBSERVING NETWORKS ACROSS EARTH SYSTEM DOMAINS INTO WIGOS**

WIGOS as a framework will provide the mechanism for better integration of observing systems in all Earth system domains in order to better respond to Earth system monitoring and prediction requirements. This is particularly the case for the following types of observations:

 Weather and climate observations of the Global Observing System (GOS) and the Global Climate Observing System (GCOS) networks,

 Atmospheric composition observations, i.e. the observing component of the Global Atmosphere Watch (GAW),

 Hydrological observations of the WMO Hydrological Observing System (WHOS),

 Cryosphere observations, i.e. the observing component of the Global Cryosphere Watch (GCW),

 Marine meteorological and oceanographic observations of the Global Ocean Observing System (GOOS).

The concept of integration of observing networks or WIGOS components may be defined as the one that follows most of the integration criteria listed below in accordance with the *Technical Regulations* ([WMO-No. 49), Volume I, Part I](https://library.wmo.int/index.php?lvl=notice_display&id=14073), and *the Manual on the WMO Integrated Global Observing System* [(WMO-No. 1160)](https://library.wmo.int/index.php?lvl=notice_display&id=19223), section 2 “Common Attributes of WIGOS Component Systems”:

 **Contribution of specific Earth system monitoring areas to the RRR in response to Vision for WIGOS in 2040**, for which observational user requirements are submitted to and maintained in OSCAR/Requirements, and Statements of Guidance are drafted and maintained for relevant application areas[[9]](#footnote-10). Establishment of new application areas for cryosphere monitoring will be investigated and consideration will be given to requirements for the monitoring of atmospheric CO2.

 **Increased data exchanged internationally** across Earth system domains leading to improved data availability including from the academic and private sectors for the benefit of various application areas. This can be done in particular by (i) facilitating submission of data through WIS using non-conventional data formats (e.g. NetCDF), (ii) facilitating access to WIS data by partner organizations and the private sector, (iii) making quality information about their observing platform data available to them.

 **WIGOS Station Identifiers (WSIs) used for both metadata and data exchange** ([see 5.8](#wigo)).

 **WIGOS metadata routinely updated into OSCAR/Surface** using new facilitating mechanisms, such as community metadata submission templates[[10]](#footnote-11), and programme specific machine-to-machine interfaces with OSCAR (e.g. OCEANOPS, Weather Radar Database, Aircraft-based Observations). Dialogue at the national level between OSCAR/Surface National Focal Points (NFPs) and partner organizations will be promoted, and nomination of OSCAR/Surface NFPs with delegation of authority for entering metadata directly in OSCAR/Surface will be encouraged.

 **Global Basic Observing Network (GBON) concept expanded to other variables supporting Global NWP and other applications:**

— Meteorological data from climate monitoring observing networks (GCOS): the GCOS Surface Network (GSN) and GCOS Upper-air Network (GUAN). Technical regulations will be updated accordingly.

— Marine meteorological observations in coastal regions where there is country jurisdiction (Exclusive Economic Zones - EEZ) as a first step[[11]](#footnote-12). For marine observations in the global ocean where there is no country jurisdiction, a second step would be required, that will take time to develop, and will be completed possibly after 2023. This second step should include WMO regional associations pursuing options to integrate with those IOC of UNESCO GOOS regional alliances (GRAs, coalitions of nations and/or institutions which share GOOS principles and goals) in close geographic proximity with the joint initial goals of coordinating open ocean observations for improving NWP and prediction of high‑impact events such as tropical cyclones (track and intensity). National Meteorological and Hydrological Services should also coordinate more closely with their National Oceanographic Institutes to advance the understanding of the role of the ocean in NWP across all time scales to improve forecasts.

— Hydrological data from NMHSs/NHSs, in particular precipitation and soil moisture (required for GNWP).

— Cryosphere data that are critical for GNWP, in particular snow water equivalent, and snow depth.

 **A WIGOS tiered approach adopted** in accordance with the Observing Network Design Principles[[12]](#footnote-13), and to be composed of: (i) reference networks building on the existing GCOS Reference Upper-air Network (GRUAN) and the new developing GCOS Surface Reference Network (GSRN); (ii) basic observing networks (such as GBON and RBON), and (iii) all other networks, including from third parties. Technical regulations will be updated accordingly.

 **WIGOS Data Quality Monitoring System (WDQMS) expanded to other domains**, from the current focus on global NWP requirements for observing stations over land, on a limited number of variables (surface pressure, temperature, humidity, and wind, and upper-air profiles) to additional ones such as CO2, snow water equivalent and/or snow depth, precipitation, solar radiation, soil moisture and temperature, and others as deemed appropriate. Investigations will be made on how to build from modelling activities in other domains (ocean, hydrology, cryosphere, atmospheric composition) with a view to providing quality monitoring information for a wider range of variables and applications.

**9. COMMUNI****CATIONS AND OUTREACH**

Communications and outreach (C&O) will play important roles also during this period, both internally and externally.

There is a continuing need to educate and interact with the Permanent Representatives, mainly due to natural turn-over and due to the fact that as WIGOS matures and gains visibility, the expectations from WMO Members will increase. In addition to the Permanent Representatives, there is also a need to engage with their observing system managers in order to keep them abreast of WIGOS developments as well as learn from their experiences with national and regional WIGOS development and implementation efforts. A particular effort should be dedicated to WMO communities that are not yet fully engaged in WIGOS, notably the hydrological advisors, the academic sector and the general public through their crowd measurements and low-cost sensors.

It is also important to engage with partners, e.g. other international organizations, NGOs and commercial entities, both to keep them informed about WIGOS developments and to foster the development of partnerships at all levels.

A number of generic C&O activities are planned:

(a) A WIGOS newsletter will be published and disseminated on a regular schedule (quarterly), targeting a broad audience with varying levels of technical knowledge;

(b) As far as possible, WIGOS side events will be arranged at all WMO constituent body sessions;

(c) The set of communications/outreach material to be showcased and shared with Members and with external partners at a variety of events (WMO constituent body sessions, national and international scientific conferences/workshops meetings of GEO, GFCS, etc.);

(d) Continuous updates of the WIGOS portal with presentations, articles, publications, examples of success stories, case studies, lessons learned, and other material for use by Members and their partners.

GCOS will collect a broad range of inputs from users on the need for climate information. This will include open calls for review and inputs, and a Climate Observations Conference in October 2021. GCOS will report on the status of the global climate observing system and on plans for its improvement to the UNFCCC in time for its global stocktake.

**10. GOVERNANCE, MANAGEMENT AND EXECUTION**

Similar to the WIGOS implementation and pre-operational phases, the development and operations of WIGOS during the 2020-2023 phase will follow the decisions taken by the World Meteorological Congress, with subsequent governance assigned to the Executive Council and its Technical Coordination Committee, and the Infrastructure Commission.

Infrastructure Commission Standing Committees on Earth Observing Systems and Monitoring Networks and on Measurements, Instrumentation and Traceability will be responsible for guiding specific aspects of WIGOS development, e.g. regulatory and guidance material, observing methodology, network design, quality monitoring, various integration issues, etc.

Developments for domain-specific observations will also be made in coordination with and using existing and new mechanisms offered by the WMO Reform, i.e. essentially:

 For climate observations and GCOS networks[[13]](#footnote-14): the Study Group of the Infrastructure Commission on the Global Climate Observing System;

 For hydrological observations: The Hydrology Coordination Panel;

 For cryosphere observations: the Study Group of the Infrastructure Commission on the WMO Cryosphere Crosscutting Functions (Global Cryosphere Watch);

 For marine meteorological and oceanographic observations: the Study Group of the Infrastructure Commission on the Global Ocean Observing System, the Joint WMO-IOC Collaborative Board, and the GOOS Steering Committee;

 For atmospheric composition observations: The Research Board.

Other relevant bodies for coordinating the implementation of this plan are:

 the Infrastructure Commission Standing Committee on Information Management and Technology;

 the Study Group of the Infrastructure Commission on the Global Basic Observing Network.

**10.1 Global level**

The management and execution functions will be carried out by the WMO Secretariat, following the guidance provided by bodies listed above. Support to all body discussions regarding WIGOS, as well as the work of study groups, expert teams and various ad hoc structures will be provided by the WMO Secretariat. For this purpose, the Secretariat will maintain a dynamic document with the list of deliverables and the required activities, keep the risks under review and mitigate them as needed, and monitor implementation of the plan using the performance indicators listed in the [annex](#Annex_draft_rec).

The WIGOS technical systems, primarily OSCAR and WDQMS, will continue to require strong management and coordination support. Many Members and partner organizations are willing and able to contribute to the activities, but it is anticipated that the global coordination role will be managed by the WMO Secretariat. To ensure that the further evolution of the WIGOS technical systems is efficient and will bring enhanced benefits for Members, INFCOM experts should be engaged in providing their guidance and recommendations; therefore, corresponding team(s) need(s) to be established by INFCOM Standing Committees to perform the activities required to meet the objectives of this Plan and progress on the Vision for WIGOS in 2040.

**10.2 Regional Level**

All regional associations are expected to establish RWCs with teams to provide governance and oversight at the regional level; the regional teams will work closely with the INFCOM Standing Committees to align regional and national implementation with the overall WIGOS plan.

Regional WIGOS teams will continue to rely on strong support from the WMO Secretariat. Their specific roles should be:

(a) Regularly (at least annually) review the WIGOS implementation efforts in their respective region;

(b) Guide and prioritize the activities listed in their R-WIP;

(c) Facilitate and coordinate regional WIGOS projects;

(d) Submit updates to the R-WIP to the regional association management group for approval;

(e) Fostering the establishment of regional WIGOS centre(s) in the respective region, providing services in all regions, by 2022;

(f) Guide the work of regional WIGOS centre(s) when established in the respective region;

(g) Organize the virtual RWC forum for sharing experiences, lessons learned;

(h) Provide regional support to Members in accordance with the R-WIP and in a response to their requests (subject to availability of resources/funds);

(i) Provide oversight and guidance on the design and establishment of the Regional Basic Observing Network in the respective region.

(j) Assist with regional mechanisms or structures for allocation of WIGOS Station Identifiers.

According to the regional WIGOS centre concept developed during the pre-operational phase, much of the support for the WIGOS implementation activities at the regional level will be provided by the RWCs. However, based on the initial experience with the regional WIGOS centre pilots during the pre-operational phase, it has become clear that the RWCs will require a substantial amount of external support capacity and strong global coordination in order for this concept to work. The global incident management system being developed in the context of WDQMS should be a major source of information for such a global coordination mechanism. It is therefore expected that the Secretariat both in Geneva and in the regional offices will have to strengthen its support for these entities. Therefore, in order to ensure that the regional and national implementation will be aligned with the WIGOS operational plan and with the Vision for WIGOS in 2040, a strong linkage between RWCs, regional WIGOS teams and the INFCOM Standing Committees is needed.

Regional associations will coordinate the establishment of regional WICAP programmes and operational centres to support AMDAR programme development and expansion.

**10.3** **National Level**

The following activities are expected to take place at a national level:

(a) Development of a National Observing Strategy, including for the design of GBON and RBON at the national level;

(b) Development of a National WIGOS Implementation Plan (N-WIP), building on the National Observing Strategy;

(c) Establishment of national WIGOS governance, coordination and implementation mechanisms and teams;

(d) Identification and mitigation of critical gaps in the WIGOS component observing systems (national RRR process implementation);

(e) Sustained and standardized operation of national observing networks/systems;

(f) Operational implementation of WIGOS Metadata Standards through populating the OSCAR/Surface database and keeping its content up-to-date;

(g) Capacity development of staff managing and operating national observing networks/systems;

(h) Development of national WIGOS partnership agreements for integration and open sharing of observations across all WIGOS component observing systems (WMO and partners);

(i) Operational implementation of national process for acting on incidents identified by the WDQMS and raised by RWCs in place;

(j) Adoption and implementation of a national policy for issuing WIGOS Station Identifiers.

The success of all the above activities at national level depends on the capacity to create trust and effective collaboration links between NMHSs, NHSs and other institutions that can contribute to, and benefit from, WIGOS.

**11. RISK ASSESSMENT**

The highest risks identified include:

(1) Uptake of OSCAR by OSCAR/Surface National Focal Points (NFPs) and submitters of metadata (including machine-to-machine transfer of metadata) is hampered by overly strict information security measures (potential impacts: misleading metadata for users with consequences on possible misuse of data, data loss, stations not being monitored by WDQMS, etc.);

(2) Update of OSCAR/Space database information is hampered by lack of response from operators of space-based observing systems (potential impact: similar to above);

(3) OSCAR is not resourced as required and thus cannot deliver expected benefits (potential impact: similar to above);

(4) Application area owners not well enough organized or connected to WMO for providing information into the RRR process (requirements, capabilities and gaps) (potential impact: key observational gaps in support of application areas not understood);

(5) Recommended impact studies not undertaken by Members due to their cost (potential impact: impact of observations on application areas not understood);

(6) Lack of responsiveness of Members to address identified key gaps (potential impact: services provided by Members on the basis of WMO applications not optimal);

(7) Failure of Members to recognize and/or connect effectively with the diversity of institutions and other entities needed to deliver the full suite of WIGOS-relevant observations (potential impact: failure to make use of existing observations for improved services);

(8) Lack of Member resource support for WICAP development (potential impact: failure to make use of additional AMDAR observations in support of Global NWP);

(9) Plans not developed/agreed for observing systems/WIGOS components to integrate and to align with WDQMS (potential impact: lack of data availability or conformance of the data with requirements);

(10) Regional WIGOS centres not established (via preparatory workshops, and subsequent agreements and commitments) (potential impact: issues with observations in the region would not be identified and not followed-up, with the consequences on conformance of the data with requirements);

(11) Regional WIGOS centres not performing the agreed regular operations (potential impact: similar to above);

(12) Non-updated contacts of OSCAR/Surface and WDQMS NFPs (potential impact: inability of the RWCs to undertake their mission and to have incidents rectified, nor of the WIGOS Data Quality Monitoring System to perform as needed);

(13) Incident management system (for RWCs) not in place/operational (potential impact: similar to above);

(14) WIGOS anticipated deliverables and outcomes are not fully realized due to 75% of the Earth’s surface not being included until ocean observations are implemented into GBON and RBON.

**12. RESOURCES**

Completion of the activities listed in the Plan will depend on the available resources.

Setting aside adequate resources for fully implementing WIGOS should be given high priority in the budget and planning processes of WMO Members. Extra resources will need to be provided to the WMO Secretariat for both staff and non-staff costs for implementation and coordination efforts going beyond the normal programmatic activities of the Secretariat. To ensure the funding needed for WIGOS implementation, provision of the following resources should be considered:

(a) WMO regular budget for WIGOS implementation support activities;

(b) WIGOS Trust Funds to supplement the WMO regular budget;

(c) In-kind contributions from Members and international partner organizations;

(d) Staff secondments;

(e) Voluntary Cooperation Programme funds for WIGOS-related technical cooperation and capacity development activities;

(f) Regional fund-raising activities to support WIGOS;

(g) Operational hosting of information systems (e.g. WIS, OSCAR, WDQMS);

(h) Provision of financial support for WICAP development and operations;

(i) Sustained resourcing of NMHSs and other institutions contributing to WIGOS-relevant observations.

**13. MONITORING AND EVALUATION**

The implementation of the Plan will be regularly monitored and evaluated using quantitative and objective methodology wherever possible. The WDQMS will be central to monitoring the implementation and performance of the observing networks themselves.

KPIs with targets and indication evaluation tools are provided in the [annex](#Annex_WOP).

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**ANNEX**

**KEY PERFORMANCE INDICATORS**

Key Performance Indicators (KPIs) are provided in the table below to help monitor the progress of WIGOS implementation.

| **No.** | **KPI** | **Priority** | **Target (2023)** | **Tool/mechanism to evaluate KPI** |
| --- | --- | --- | --- | --- |
| 1 | National WIGOS Implementation Plans adopted/approved by a majority of WMO Members | National Implementation | 75 % of WMO Members | Percentage of Members |
| 2 | National WIGOS governance mechanism established | National Implementation | 75 % of WMO Members | Percentage of Members |
| 3 | National WIGOS partnership agreements implemented | National Implementation | 75 % of WMO Members | Percentage of Members |
| 4 | WIGOS Station Identifiers implemented | National Implementation | 75 % of WMO Members | Percentage of Members |
| 5 | WIGOS metadata implemented in OSCAR/Surface for all reporting stations | National Implementation | 75 % of WMO Members | Percentage of Members |
| 6 | Processes in place for acting on issues and incidents received from the WDQMS | National Implementation | 75 % of WMO Members | Percentage of Members |
| 7 | Members affiliated with RWC | National Implementation | 75 % of WMO Members | Percentage of Members |
| 8 | Number of variables considered in WDQMS webtool | WDQMS | 70 % | Percentage of targeted variables (10) |
| 9 | Number of WIGOS observing components/domains integrated in WDQMS webtool | WDQMS | 4[[14]](#footnote-15) | Simple count of WIGOS observing components/domains |
| 10 | Number of GBON Stations established | GBON/RBON | 700[[15]](#footnote-16) | Simple count of station in OSCAR/Surface |
| 11 | Number of RBON Stations established addressing requirements other than NWP and climate | GBON/RBON | 1000 | Simple count of station in OSCAR/Surface |
| 12 | Pilot GSRN Active | GCOS | One Lead Centre Active | GSRN Lead Centre Reporting |
| 13 | Number of certified GRUAN stations delivering to WIGOS | GCOS | 20 | GRUAN Lead Centre Reporting |
| 14 | Climate observing system status report delivered to WMO and UNFCCC before end 2021 | GCOS | One report | Publication |
| 15 | Number of regions with at least one established Regional WIGOS Centre | Regional WIGOS centres | 7  (6 regions plus Antarctica) | Simple count |
| 16 | Percentage of WIGOS Metadata complete in OSCAR/Surface | OSCAR | 75 | Average of platform completeness index as provided by OSCAR/Surface |
| 17 | Number of component databases[[16]](#footnote-17) interfaced with OSCAR/Surface | OSCAR | 7 | Simple count |
| 18 | Number of countries using machine-to-machine interface with OSCAR/Surface (XML files) | OSCAR | 25 % of WMO Members | Percentage of Members |
| 19 | Number of GOOS Essential Ocean Variables (EOV) implemented by GBON/RBON for NWP and forecasting of High Impact Events | GBON/RBON | 10 | OSCAR, RRR |

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1. The Plan for the WIGOS Initial Operational Phase (2020-2023) will be finalized for its submission to EC-73 in accordance with Recommendation 4.1.1(1)/1 (INFCOM-1). [↑](#footnote-ref-2)
2. See list of application areas with their [Statements of Guidance](https://community.wmo.int/rolling-review-requirements-process) [↑](#footnote-ref-3)
3. <https://oscar.wmo.int/surface> [↑](#footnote-ref-4)
4. <https://www.wmo-sat.info/oscar/observingrequirements> [↑](#footnote-ref-5)
5. “Substantial Majority” in this context means more than 75 % of WMO Members [↑](#footnote-ref-6)
6. <https://www.wmo.int/pages/prog/www/wigos/wigos-readiness.html> [↑](#footnote-ref-7)
7. Integration is across all Earth system domains with consistent approaches regarding data exchange, collection of WIGOS metadata, quality monitoring and incident management, and the use of capacity development instruments such as the Systematic Observations Financial Facility (SOFF) [↑](#footnote-ref-8)
8. For example, the WMO-IOC Collaborative Board offers an opportunity to better align WMO and IOC strategies in support of WIGOS and GOOS. [↑](#footnote-ref-9)
9. Ocean application, climate monitoring (GCOS), hydrology and water resources, Forecasting Atmospheric Composition, Monitoring Atmospheric Composition, and Providing Atmospheric Composition information to support services in urban and populated areas. [↑](#footnote-ref-10)
10. Such templates are designed to facilitate the submission of WIGOS metadata to OSCAR/Surface for specific types of observing platforms (e.g. GCW observing stations). [↑](#footnote-ref-11)
11. See also Resolution 45 (Cg-18) - Ensuring adequate marine meteorological and oceanographic observations and data coverage for the safety of navigation and the protection of life and property in coastal and offshore areas, which offers justification for such GBON expansion into the ocean. [↑](#footnote-ref-12)
12. WIGOS Observing Network Design Principle No. 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. [↑](#footnote-ref-13)
13. GCOS Upper-air Network (GUAN), GCOS Reference Upper-air Network (GRUAN), GCOS Surface Network (GSN), and the new GCOS Reference Surface Network (GSRN). [↑](#footnote-ref-14)
14. Weather, Climate, Marine observations, Aircraft observations [↑](#footnote-ref-15)
15. Target of 500km x 500 km horizontal resolution over land surface [↑](#footnote-ref-16)
16. GCW, JCOMMOPS, WRD, Hydrology, OSCAR/Requirements, CPDB, WDQMS [↑](#footnote-ref-17)