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| WEATHER CLIMATE WATER | **World Meteorological Organization**  **COMMISSION FOR OBSERVATION, INFRASTRUCTURE AND INFORMATION SYSTEMS**  **Second Session** 24 to 28 October 2022, Geneva | **INFCOM-2/Doc. 6.1(1)** |
| Submitted by: Chair, SC-ON  30.IX.2022  **DRAFT 1** |

**AGENDA ITEM 6: TECHNICAL REGULATIONS AND OTHER TECHNICAL DECISIONS**

**AGENDA ITEM 6.1: Standing Committee on Earth Observing Systems and Monitoring Networks (SC-ON)**

# High Level Guidance on the evolution of global observing systems during the period 2023-2027 in response to the Vision for WIGOS in 2040

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| **Summary** |
| **Document presented by:** the chair of SC-ON, to address [Resolution 38 (Cg-18)](https://library.wmo.int/doc_num.php?explnum_id=9827/#page=137) – Vision for the WMO Integrated Global Observing System in 2040, ([WMO-No. 1243](https://library.wmo.int/index.php?lvl=notice_display&id=21716#.Yh8okOjMKgY)), which requested INFCOM to undertake the necessary planning activities that will help Members and partner organizations respond to the Vision for WIGOS in 2040.  **Strategic objective 2020–2023:** 2.1 and its strategic output 2.1.4 – Response to the WIGOS Vision 2040 during 2020–2023, including consideration of Earth System prediction requirements and urban services.  **Financial and administrative implications:** It is within the parameters of the Strategic and Operational Plans 2020–2023, and will be reflected in the Strategic and Operational Plans 2024–2027.  **Key implementers:** INFCOM in consultation with SERCOM, HCP, the Research Board and regional associations.  **Time frame:** 2023-2027.  **Action expected:** Review and adopt the proposed draft recommendation to Congress. |

# GENERAL CONSIDERATIONS

Congress adopted [Resolution 38 (Cg-18)](https://library.wmo.int/doc_num.php?explnum_id=9827/#page=137) – Vision for the WMO Integrated Global Observing System in 2040, and requested INFCOM to undertake the necessary planning activities that will help Members and partner organizations respond to the Vision for WIGOS in 2040.

SC-ON and its Joint Expert Team on Earth Observing Systems Design and Evolution (JET‑EOSDE) has therefore been working closely with Experts in WMO applications and surface- and space-based observing systems implementers in the weather, climate, hydrology, atmospheric composition, oceans, cryosphere, and space weather domains to address identified observational gaps and provide guidance to WMO Members for key activities to be implemented within the next five years to accomplish the Vision for WIGOS in 2040.[[1]](#footnote-2) The guidance, which is submitted to INFCOM as a draft Recommendation to Congress, 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 also identifies urgent specific actions arising as a consequence of WMO’s Earth System approach and priorities of WIGOS, WMO programmes, and existing data gaps.

The [*WMO Strategic Plan 2020-2023*](https://library.wmo.int/index.php?lvl=notice_display&id=21525) (WMO-No. 1225) requests improved access to, and exchange of Earth System observation data. The Strategic Plan considers Global Numerical Weather Prediction (NWP) as foundational and proposes advancement to further harmonize procedures across Earth system domains. The extension to all domains will result in a deeper understanding of the state of the environment, and it yields additional priorities for the next five years when implementing the Vision for 2040.

The guidance compiled is the result of WMO priorities written in a manner that is simple and easy to use by all actors and is based on several ongoing activities aimed at maintaining and developing all WMO component observing systems.

# DRAFT RECOMMENDATIONS

## Draft Recommendation 6.1(1)/1 (INFCOM-2)

### High Level Guidance on the evolution of global observing systems during the period 2023-2027 in response to the Vision for WIGOS in 2040

The Commission for Observation, Infrastructure and Information Systems,

**Recalling** [Resolution 6 (INFCOM-1)](https://library.wmo.int/doc_num.php?explnum_id=11197/#page=85) – Review of the work programme of the Commission, and output 2.1.4 – Response to the WIGOS Vision 2040 during 2020–2023, including consideration of Earth system prediction requirements and urban services,

**Having examined** the draft High Level Guidance on the evolution of global observing systems during the period 2023-2027 in response to the Vision for WIGOS in 2040 (HLG) produced by the Standing Committee on Earth Observing Systems and Monitoring Networks (SC-ON),

**Noting** that the HLG is an outcome of the WMO Rolling Review of Requirements and has been extensively reviewed by experts of the Infrastructure Commission, the Services Commission the Research Board, and co-sponsored programmes,

**Recommends** to the World Meteorological Congress the adoption of the HLGthroughthe draft resolution provided in the [Annex](#ANNEXTODRAFTRECOMMENDATION) to this Recommendation.

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## Annex to draft Recommendation 6.1(1)/1 (INFCOM-2)

**Draft Resolution ##/1 (Cg-19)**

**High Level Guidance on the evolution of global observing systems during the period 2023-2027 in response to the Vision for WIGOS in 2040**

THE WORLD METEOROLOGICAL CONGRESS,

**Recalling:**

1. The long-term goals and strategic objectives of the Organization as laid out in the [*WMO Strategic Plan 2020–2023*](https://library.wmo.int/index.php?lvl=notice_display&id=21525#.YGMgqkBuKUl)(WMO-No. 1225), and its long-term goal 2, Enhance Earth system observations and predictions: Strengthening the technical foundation for the future,
2. [Resolution 38 (Cg-18)](https://library.wmo.int/doc_num.php?explnum_id=9827/#page=137) and the [*Vision for the WMO Integrated Global Observing System in 2040*](https://library.wmo.int/index.php?lvl=notice_display&id=21716#.Yh8okOjMKgY) (WMO-No. 1243),
3. [Resolution 40 (Cg-18)](https://library.wmo.int/doc_num.php?explnum_id=9827/#page=144) – Members’ contribution to the actions specified in the Implementation Plan for the Evolution of Global Observing Systems, in the context of the future WMO Integrated Global Observing System implementation plan,
4. [Resolution 1 (Cg-Ext(2021)](https://library.wmo.int/doc_num.php?explnum_id=11113/#page=9)) – WMO Unified Policy for the International Exchange of Earth System Data,
5. [Resolution 2 (Cg-Ext(2021)](https://library.wmo.int/doc_num.php?explnum_id=11113/#page=29)) – Amendments to the Technical Regulations related to the establishment of the Global Basic Observing Network (GBON),
6. [Resolution 9 (EC-73)](https://library.wmo.int/doc_num.php?explnum_id=11008/#page=35) – Plan for the WMO Integrated Global Observing System Initial Operational Phase (2020–2023),
7. WIGOS Technical Report No. 2013-4 - Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP, WIGOS TR-No. 2013-4),

**Recalling further** 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,

**Having considered**Draft Recommendation 6.1(1)/1 (INFCOM-2),

**Adopts** 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 (HLG), which Executive Summary is provided in [Annex 1](#ANNEXTODRAFTRESOLUTION) to this Resolution [the complete version of the document is available as Cg-19/INF. XX];

**Decides** that the WIGOS TR-No. 2013-4 has become obsolete since it was responding to the Vision for the Global Observing System in 2025, and is now replaced by the HLG;

**Urges** Members to:

1. Take into account the HLG when evolving their observing systems;
2. Undertake necessary actions to address priority actions listed in the HLG;

**Requests** the Executive Council to keep the HLG under review and adopt updates as needed;

**Requests** the Presidents of regional associations to support and monitor the implementation of this resolution within their regions;

**Requests** the President of the Infrastructure Commission to:

1. Monitor implementation of this resolution by Members;
2. Consider whether and how specific priority actions from the HLG could be turned into new or updated technical regulations;
3. Propose update of the HLG to the Executive Council to reflect evolution of end user requirements and of observing technology;

**Requests** the President of the Services Commission, and the Chair of the Research Board, and other relevant bodies, to collaborate with the President of the Infrastructure Commission for the passing of their evolving requirements to the Infrastructure Commission and their consideration in the WMO Rolling Review of Requirements for future updates of the HLG;

**Requests** the Secretary-General to:

(1) Publish the HLG (English only) and its Executive Summary (in all WMO languages) and bring it to the attention of Members and identified agents;

(2) Strengthen effective coordination with relevant WMO partners and stakeholders on matters related to the implementation of priority actions of the HLG.

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[Annex 1](#ANNEXTODRAFTRESOLUTION): Executive Summary of 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.

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See [INFCOM-2/INF. 6.1(1)](https://meetings.wmo.int/INFCOM-2/InformationDocuments/Forms/AllItems.aspx) for more information.

## Annex to draft Resolution ##/1 (Cg-19)

### Executive Summary of 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

**Rationale**

1. The purpose of this document is to provide guidance to WMO Members for key activities to be implemented within the next five years to accomplish the Vision for the WMO Integrated Global Observing System (WIGOS) in 2040.[[2]](#footnote-3) 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 also identifies urgent specific actions arising as a consequence of WMO’s Earth System approach and priorities of WIGOS, WMO programmes; and existing data gaps.
2. The Vision for WIGOS in 2040 presents a likely scenario for how user requirements for observational data may evolve in the next few decades. With this information National Meteorological and Hydrological Services (NMHSs), space agencies and other observing system designers will be able to adapt their planning activities accordingly to develop the space-based and surface-based components of the WIGOS. The current High Level Guidance document focuses on the time frame of the next five years and gives recommendations on activities needed now.
3. It adopts a less descriptive approach than the predecessor “Implementation for the Evolution of Global Observing Systems (EGOS-IP)” which accompanied the “Vision for the Global Observing System in 2025”. The guidance compiled in the current document is the result of WMO priorities written in a manner that is simple and easy to use by all actors and is based on several ongoing activities aimed at maintaining and developing all WMO component observing systems:
4. The Vision for the WMO Integrated Observing System in 2040, adopted by the World Meteorological Congress in June 2019 through [Resolution 38 (Cg-18)](https://library.wmo.int/doc_num.php?explnum_id=9827/#page=137);
5. The Plan for the Initial WIGOS Operational Phase 2020-2023, adopted by the Executive Council through [Resolution 9 (EC-73)](https://library.wmo.int/doc_num.php?explnum_id=11008/#page=35), including implementation of GBON per [Resolution 2 (Cg-Ext.(2021))](https://library.wmo.int/doc_num.php?explnum_id=11113/#page=29), supported by the Systematic Observation Financing Facility (SOFF) for the Least Developed Countries (LDCs) and Small Island Developing Countries (SIDS);
6. The WMO Unified Policy for the International Exchange of Earth System Data adopted by Extraordinary Congress in 2021 through [Resolution 1 (Cg-Ext.(2021))](https://library.wmo.int/doc_num.php?explnum_id=11113/#page=9);
7. The first Session of the WMO Commission for Observation, Infrastructure and Information Systems (INFCOM) tasked in May 2020 its Standing Committee on Earth Observing Systems and Monitoring Networks (SC-ON) to deliver updated guidance on Observing Network design and Outreach;
8. The work of Global Climate Observing System (GCOS) in monitoring the performance of the climate observation systems described in the GCOS Status Report 2021 and the actions contained in the GCOS Implementation Plan 2022 that if completed will improve climate observations and climate services that depend on them.
9. Under the Joint Expert Team on Earth Observing Systems Design and Evolution (JET-EOSDE) a working group was established to draft a guidance document for the evolution of the global observing capabilities. Experts from weather, climate, hydrology, atmospheric composition, oceans, cryosphere, and space weather were involved in drafting the guidance document. During the review stage, which started in July 2021, feedback was collected from SC-ON and its expert teams, INFCOM Standing Committees and relevant Study Groups, SERCOM and the Research Board and others. Their comments were considered by the working group and improvements implemented. Finally, the document was approved by the INFCOM Management Group and submitted to INFCOM-2 in late 2022 as a draft Recommendation to the 19th World Meteorological Congress, which adopted it per Resolution XXX (Cg-19).
10. The [*WMO Strategic Plan of WMO 2020-2023*](https://library.wmo.int/index.php?lvl=notice_display&id=21525) (WMO-No. 1225) requests improved access to, and exchange of Earth System observation data. The Strategic Plan considers global NWP as foundational and proposes advancement to further harmonize procedures across Earth system domains. The extension to all domains will result in a deeper understanding of the state of the environment, and it yields additional priorities for the next five years when implementing the Vision for 2040.

**Structure of the document**

1. The High Level Guidance document compiles information from several areas of high priority for the evolution of the observing system. Such priorities have to be incorporated to realize concrete improvements of observing system capabilities over the next five years. The document is not meant to provide a comprehensive list of actions but to focus instead on high priority actions and recommendations that can have substantial impact on WMO application areas.
2. The **first section** looks at key observational gaps from the Statements of Guidance of Application Areas and latest findings and recommendations from WMO impact of observations workshops. Gap analyses for all components of the Earth System domains and priorities set by the WMO Strategic Plan result in key aspects of activities for the evolution of the observing systems during the next five years.
3. The **second section** looks at the status and developments for space-based and surface-based observations. New strategic programme activities of WMO such as (i) the 2020 reviewed baseline configuration of meteorological satellites and (ii) new opportunities by commercial satellite data providers, (iii) the expansion of the Global Basic Observing Network (GBON, see below), and the relationship to the Regional Basic Observing Network (RBON), (iv) opportunities for regional cooperation, (v) the Integrated Urban Services concept, (vi) the use of new observing technologies, (vii) the new WMO policy for the international exchange of Earth System data and (viii) the use of observational data from the private sector will be explained. The new strategic activities explained in the second section result in recommended actions for Members with high priorities.
4. The **third section** gives an example on national realization of a strategy for the implementation of the Vision for WIGOS in 2040.
5. The **fourth section** gives guidance on capacity development opportunities and SOFF, see below initiative and, finally, a communication plan is presented.
6. The **Annexes** give further, more detailed, information for the interested reader. Annex 1 gives advice on how the relevant WIGOS documents, tools and regulatory material are linked. Annex 2 provides an overview of observational gaps extracted from the Statements of Guidance of WMO Application Areas, with indication of available and emerging technologies, and some comments or recommendations to be considered. Annex 3 lists key actions from the EGOS-IP to be carried out by Members (Annex of [Resolution 40 (Cg-18](https://library.wmo.int/doc_num.php?explnum_id=9827/#page=144))). Annex 4 gives an overview on GBON requirements, Annex 5 details the Integrated Urban Services requirements and priorities and Annex 6 lists atmospheric composition variables needed in support of monitoring and forecasting applications.

**Main results of the document**

1. In the High Level Guidance document, the following topics will be discussed:

**Statements of Guidance, taking overarching priorities of WMO into account**

1. The consensus view on user requirements for observational data and the design of WMO integrated observing systems is the result of the Rolling Requirements Review (RRR) process. Through the Statements of Guidance, experts in each application area consider the extent to which the current capabilities meet the stated requirements. Some of the Statements of Guidance are up to date, for other areas arrangements to obtain updates have been taken. The Global Cryosphere Watch (GCW), GCOS, the Global Atmosphere Watch (GAW) and the WMO Hydrological Observing System (WHOS) have worked towards high level statements which are included in this document. Taking WMO’s Earth System approach and the foundational role of global NWP into account, the guidance document considered the following key drivers[[3]](#footnote-4) and priorities for the evolution of the observing system:
2. Better protection of life & property, disaster risk and impact reduction;
3. Improving societal and socioeconomic benefits;
4. Areas with high priority:
5. Global NWP, with particular attention to GBON and interfaces between Earth System domains: Atmosphere – Ocean, -Land, -Cryosphere, - Hydrosphere;
6. Climate monitoring, applications and services;
7. Sub-seasonal to longer range prediction;
8. Greenhouse Gas monitoring and prediction;
9. Hydrological monitoring and Services for Water management.
10. For all of these areas this guidance document gives a synthesis of key observational gaps together with recommendations on how to fill them, taking the above stated priorities into account.

**Climate Observations**

1. GCOS, in its 2021 Status Report, has identified some key areas that need to be addressed to improve climate observations and the climate services that depend on them:
2. Assuring long-term continuity of some satellite observations;
3. Ensuring sustained funding, long-term, for in situ observations;
4. Implementing WMO’s Global Basic Observing Network (GBON) and the Systematic Observations Financing Facility (SOFF);
5. Addressing gaps in situ observations particularly over parts of Africa, South America, South-east Asia, the deep ocean, and polar regions;
6. Preserving, in perpetuity, the fundamental climate data records is essential;
7. Data rescue;
8. Improving observations of the Earth System Climate Cycles: the energy balance, carbon and water cycles;
9. Monitoring of Extremes and to support Adaptation and the Paris Agreement.

**Findings from latest NWP impact of observations workshops and other domains**

1. The WMO series of workshops on the impact of various observing systems on NWP has significant influence on the overall development of the observing system and on the associated WMO regulatory and guidance material, such as GBON and RBON. The series of workshops is a key contributor to the RRR process and the recommendations from the workshop have a significant influence on national implementation activities of Members. The Earth System approach provides opportunities for cooperation across the different domains **weather, climate, hydrology, atmospheric composition, oceans, cryosphere, and space weather**. The guidance document presents results from NWP and other WMO application areas with respect to observations in all domains.

**Developments of the space-based observations**

1. The space-based backbone component of the WIGOS Vision 2040 is based on a system of sun-synchronous low-earth-orbit satellites in three orbital planes and a ring of geostationary satellites providing complete coverage outside the polar areas, complemented by satellites in other orbit planes and satellites in drifting orbits.
2. The CGMS [“Baseline](https://www.cgms-info.org/documents/CGMS_Baseline_v3-2021.pdf)” configuration constitutes the commitments and plans of CGMS members to provide particular observations and services in support to WIGOS. The 2020 review of the CGMS baseline concluded that the baseline is still a comprehensive response to the Vision for WIGOS in 2040, addressing the key application areas. CGMS agreed to include additional measurement capabilities in the baseline configuration. A number of new satellite programmes are planned that offer the potential to expand the response to the Vision for WIGOS (see [CGMS High Level Priority Plan](https://www.cgms-info.org/documents/CGMS_HIGH_LEVEL_PRIORITY_PLAN.pdf)). The latest WMO position on the baseline satellite data requirements were adopted in an INFCOM decision in 2021 on “satellite data requirements of global NWP” which captures the established requirements for the exchange of satellite data for global NWP with a view for the next 5-10 years and aligns itself with the RRR process and the Vision for WIGOS in 2040.
3. In-orbit calibration reference measurements are strongly required in future. In that sense, the polar orbiting baseline system today performs two separate functions i) baseline observations and ii) reference measurements for calibration. An optimized future architecture for calibration reference measurements must therefore be studied.
4. The Committee on Earth Observation Satellites (CEOS) has developed the concept of space-based Virtual Constellations. They coordinate space-based observations, ground‑based observations for calibration and validation, and/or data delivery systems to meet a common set of requirements within a specific domain.
5. Commercial satellite data have already demonstrated their quality and their impact on NWP, especially with radio occultation measurements. A number of additional commercial missions have been conducted and it is to be expected that more and more space agencies will utilize private sector satellite missions together with the governmental missions.

**Surface-based observations: latest developments to be considered when proposing specific actions to Members**

1. The GBON is a subset of the surface-based subsystem of WIGOS to contribute to meeting the requirements of Global NWP and climate monitoring. GBON sets out an obligation and clear requirements for all WMO Members to acquire and exchange internationally the most essential surface-based observational data for Global NWP and climate data re-analysis. SOFF will support LDCs and SIDS to generate and exchange basic observational data critical for GBON. SOFF is established to provide a new means of technical and financial support for the operation of GBON in those countries. Their international data exchange will be used as a measure of success. WMO and its Members in collaboration with partners are requested to mobilize the financial resources required. INFCOM is also tasked to develop technical guidelines to implement GBON. Regional requirements for WMO application areas will also be considered with the implementation of RBON.
2. Regional and global cooperation on implementation, improvement and maintenance of observing networks can bring significant enhanced capability by delivering more and improved observations, which Members would not be able to deliver on a national basis. Examples of successful cooperation programmes are given, in particular the global AMDAR programme and the regional EUMETNET-EUCOS network, to encourage Members to join these or to support opportunities for synergies in their Region.
3. In the near future the majority of the world’s population will live in urban centres with safety and security, the environment, critical infrastructure and the economy to protect. The scope of Integrated Urban Services (IUS) includes climate, water, environment. The [*Guidance on Integrated Urban Hydrometeorological, Climate and Environmental Services*](https://library.wmo.int/index.php?lvl=notice_display&id=21855)(WMO-No. 1234) provides a basis to assist WMO Members in the development and implementation of IUS. Annex 5 of this document provides an extended discussion on the gaps of IUS for WIGOS. Recommendations which are made in this High Level Guidance document are related to the generation of a global database on information about the urban environment, the establishment of IUS reference stations and on global IUS observing network concepts.
4. To introduce any new observing system a strategy is needed to transition new technologies to operation. SC-MINT, through Measurement Lead Centres, expert teams and Regional Instrument Centres play a crucial role in this context. A tiered network concept, which was originally developed for GCOS, is now being considered also for other networks by INFCOM with the goal to be an important development for the evolution of WIGOS.
5. Over recent years, WMO, in cooperation with various partners, has been developing a new approach for greater engagement between the public, private and academic sectors operating in the global weather enterprise. WMO refined guidance and policies at EC-70 and Cg-18 to encourage and enable Members to pursue mutually beneficial partnerships. The High Level Guidance document gives examples how Members might develop partnerships with the private sector. In addition, examples of different crowdsourced data and their use in observing networks of Member countries are given.

**Actions with high priorities regarding the evolution of the observing systems for the next five years; examples of priority actions.**

1. Due to the clear strategic direction of WMO and activities aimed to develop the observing component WIGOS and considering that global NWP is regarded as a foundational application area for the Earth System approach, a subset of actions of high priority are recommended when implementing the WIGOS over the next five years. The recommended actions are based on expert knowledge from the Application Areas and the INFCOM Joint Expert Team on Earth Observing System Design and Evolution, supported by additional experts during the review process.

**General recommendations to Members for 2023-2027 are (in condensed form):**

1. Implement the GBON concept, supported by the SOFF for LDCs and SIDS;
2. Implement the new WMO Unified Policy for the International Exchange of Earth System Data;
3. Members (and Space Agencies) to advance the implementation of the WIGOS Vision 2040, for instance wind lidar and a comprehensive space-based carbon monitoring system;
4. Members (and Space Agencies) to respond to the satellite data needs as expressed in WMO position papers;
5. Ensure that all operators produce observations in accordance to WIS and WIGOS rules and standards;
6. Support the development of a tiered network concept by INFCOM;
7. Members to take continued actions to protect radio frequencies for meteorological applications;
8. Support establishing standards and best practices for several types of measurements through cooperation between developed and developing countries, enhance training and share experience;
9. Investigate and develop new emerging measurement technologies (listed in Annex 2 of the document);
10. Respond to the 2022 GCOS Implementation Plan (see the WMO/NMHS Supplement to the 2022 GCOS Implementation Plan).

**Recommendations to Members on the Evolution of Observing Systems for 2023-2027 are (in condensed form):**

1. Exchange internationally all observations that have a demonstrated positive impact on Global NWP, in compliance with GBON and the new WMO unified policy for the international exchange of Earth system data;
2. More timely availability and wider distribution of several types of in situ and remote sensed measurements;
3. Exchange more observations of ice thickness, snow depth, water equivalent of snow cover, soil moisture and ocean surface salinity;
4. Global dissemination of radiosonde measurements (High-resolution Binary Universal Form for the Representation of meteorological data (BUFR), measurements from descending radiosondes, re-activate silent radiosonde stations);
5. Develop network of remote sensing profiling stations;
6. Wider distribution of weather radar data standardize products and formats, at least regional data exchange and long-term archive;
7. Continued efforts to extend the coverage for aircraft data;
8. Integrate, extend, and sustain hydrological observations of WHOS in compliance with WIGOS standards and share the data in support of hydrological monitoring system;
9. More and sustained surface-based observations of the physical ocean;
10. More studies are encouraged on the cost-effectiveness of observing systems.

**Specific recommendations to Members for sensor technology for 2023-2027 are (in condensed form):**

1. Install more ground-based Global Navigation Satellite System (GNSS) stations;
2. Extend spatial density of Doppler wind profilers;
3. Evaluate new lidar systems for routine profiling of temperature and water vapour;
4. Install water level and tide gauges for monitoring of sea level rise;
5. Allocate resources and plan for assessment of new technologies across Earth System domains for systematic use in complement to standard measurements.
6. Annex 2, Statements of Guidance Gap Overview per Variable, lists available technologies to address existing gaps with recommended actions and gives comments on costs, complementary of technologies and capacity development aspects.

**Specific recommendations to Members for Integrated Urban Services for Members for 2023-2027 are (in condensed form):**

1. Establish metadata information about the urban environment;
2. Establish integrated collaborative IUS reference stations;
3. Develop IUS urban observation networks through collaboration and cooperation and their demonstration;
4. Expand support of Greenhouse Gas mitigation efforts in cities and other sub-national stakeholders through further cooperation with Members.

**Specific recommendations for Members for Space Systems, 2023-2027 are (in condensed form):**

1. Advance:
2. The space component of the Greenhouse Gas monitoring system;
3. The new generation of GEO satellites;
4. The atmospheric Radio Occultation constellation:
5. Work towards:
6. Operational hourly daytime UV/VIS mapping of air quality from GEO orbit;
7. Achieving scatterometer measurements achieving the 6-hourly requirement;
8. Operational 3D wind profile observations from space-based lidar;
9. Providing global hourly Microwave sounding observations;
10. Providing continuity of precipitation radar measurements;
11. Provide operational altimetry measurements for very high latitudes cryospheric monitoring;
12. Enhance satellite observations as an integral part of the observing system taking into consideration needs for atmospheric composition observations;
13. Ensure continuity of MR/IR limb sounding observations;
14. Study the architecture for future absolute calibration reference missions, covering VIS/NIR, IR and MW.

**Unified data policy**

1. The long-term goals and strategic objectives of the WMO as outlined in the Strategic Plan and the Vision for WIGOS in 2040 require more data from a broadening range of disciplines and sources.
2. The WMO started in 2019 with the Geneva Declaration the broad discussion to enhance free and unrestricted exchange of meteorological, climatological, hydrological and related environmental information and services. The Extraordinary Session of the WMO Congress in October 2021 agreed to have one unified data policy for all WMO domains and disciplines. The adopted [Resolution 1 (Cg-Ext.(2021))](https://library.wmo.int/doc_num.php?explnum_id=11113/#page=9) on WMO Unified Data Policy for the International Exchange of Earth System Data defines guidelines on what constitutes “core data” within seven domains and provides guidance to stakeholders in the area of research and public private engagement. It also identifies certain “recommended data” that should be exchanged by Members to support Earth System monitoring and prediction efforts. Technical regulations to support the implementation of this resolution were adopted by the 19th World Meteorological Congress in 2023.

**Examples of national implementation strategy**

1. The guidance document includes an example of how a developed NMHS proceeded to develop a national strategy on the evolution of their observing system in the direction of the Vision for WIGOS for 2040.

**Capacity development opportunities**

1. Latest developments concerning capacity development and training opportunities including SOFF and the Country Support Initiative, and technical cooperation programmes for meteorological observing systems are described in some detail and high level recommendations are addressed.
2. The current version of the High Level Guidance document is seen as a living document and will be updated according to WMO strategic developments and the future evolution of the observing components.
3. The World Meteorological Congress welcomes the High Level Guidance document developed by INFCOM and recommends its consideration by Members for their national observing strategies and evolution of observing systems at the national level.

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1. <https://community.wmo.int/vision2040> [↑](#footnote-ref-2)
2. <https://community.wmo.int/vision2040> [↑](#footnote-ref-3)
3. These key drivers have been identified as key for this document during a JET-EOSDE meeting, this is not an exhaustive list. [↑](#footnote-ref-4)