**WORLD METEOROLOGICAL ORGANIZATION**

**Global Basic Observing Network (GBON) Design Workshop**

***Geneva, Switzerland, 23-25 July 2018***

**FINAL REPORT**

****



DISCLAIMER

**Regulation 42**

Recommendations of working groups shall have no status within the Organization until they have been approved by the responsible constituent body. In the case of joint working groups the recommendations must be concurred with by the presidents of the constituent bodies concerned before being submitted to the designated constituent body.

**Regulation 43**

In the case of a recommendation made by a working group between sessions of the responsible constituent body, either in a session of a working group or by correspondence, the president of the body may, as an exceptional measure, approve the recommendation on behalf of the constituent body when the matter is, in his opinion, urgent, and does not appear to imply new obligations for Members. He may then submit this recommendation for adoption by the Executive Council or to the President of the Organization for action in accordance with Regulation 9(5).

© World Meteorological Organization, 2018

The right of publication in print, electronic and any other form and in any language is reserved by WMO. Short extracts from WMO publications may be reproduced without authorization provided that the complete source is clearly indicated. Editorial correspondence and requests to publish, reproduce or translate this publication (articles) in part or in whole should be addressed to:

Chairperson, Publications Board

World Meteorological Organization (WMO)

7 bis, avenue de la Paix Tel.: +41 (0)22 730 84 03

P.O. Box No. 2300 Fax: +41 (0)22 730 80 40

CH-1211 Geneva 2, Switzerland E-mail: [Publications@wmo.int](mailto:Publications@wmo.int)

NOTE:

The designations employed in WMO publications and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of WMO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Opinions expressed in WMO publications are those of the authors and do not necessarily reflect those of WMO. The mention of specific companies or products does not imply that they are endorsed or recommended by WMO in preference to others of a similar nature which are not mentioned or advertised.

This document (or report) is not an official publication of WMO and has not been subjected to its standard editorial procedures. The views expressed herein do not necessarily have the endorsement of the Organization.

\_\_\_\_\_\_\_\_\_\_\_\_

|  |
| --- |
| **CONTENTS** |
|  |
| [AGENDA](#AGENDA) |
| [Executive Summary](#EX_SUMMARY) |
| [General Summary](#GENERAL_SUMMARY) |
| [List of Participants](#Appendix_I) (Appendix I) |
| [GBON Concept](#Appendix_II) (Appendix II) |

\_\_\_\_\_\_\_\_\_\_\_\_

**Agenda**

1. **Organization of the Session**
2. **RELEVANT DECISIONS FROM CBS-TECO-2018, CBS-MG, CGMS-46, AND EC-70**
3. **WDQMS Pilot: Current status of data sharing for global NWP**
4. **MEMBERS’ Compliance with Manual on the Global Observing System and CBS Recommendations; Rationale for GBON**
5. **Scientific basis for GBON design** 
   1. Fifth WMO Workshop on the impact of various observing systems on NWP, Sedona 2012
   2. Sixth WMO Workshop on the impact of various observing systems on NWP, Shanghai 2016
   3. IPET/OSDE recommendations
6. **Review of the RBON Concept and draft RBON Provisions in the manual on wigos (WMO-No. 1160)**
7. **GBoN DESIGN**
   1. NWP and Climate Monitoring Requirements in OSCAR/Requirements and Statements of Guidance
   2. Observing Network Design Principles
   3. Climate Monitoring Principles
   4. GBON Key Requirements (accuracy, spatial and temporal resolutions and timeliness)
8. **DRAFT GBoN PROVISIONS IN THE MANUAL ON WIGOS**
9. **Requirements from application areas other than Global NWP and Climate Monitoring**
10. **WAY FORWARD**
11. **CLOSURE OF THE SESSION**

\_\_\_\_\_\_\_\_\_\_

**Executive Summary**

The Global Basic Observing Network (GBON) Design Workshop was held at the WMO Headquarters in Geneva, Switzerland, from 23 to 25 July 2018. The session was chaired by Dr Anthony Rea (Australia), Co-Chair CBS/OPAG-IOS.

Based on the outcomes from the breakout groups, the GBON Concept was drafted; it was further developed after the workshop and its latest version is reproduced in [Appendix II](#Appendix_II).

\_\_\_\_\_\_\_\_\_

**General summary**

**1.** **ORGANIZATION OF THE SESSION**

**1.1 Opening of the meeting**

1.1.1 The Global Basic Observing Network (GBON) Design Workshop was held at the WMO Headquarters in Geneva, Switzerland, from 23 to 25 July 2018. The session was chaired by Dr Anthony Rea (Australia), Chair CBS/OPAG-IOS. The Chair welcomed the participants to the meeting, and expressed his wishes for a successful session.

1.1.2 Dr F. Belda, D/OBS welcomed the participants; he underlined the essential role played by global applications such as numerical weather prediction and climate analysis as a backbone for all products and services provided by all WMO Members to their constituencies, even at regional and local levels.

1.1.3 There is a continued need to serve these global applications with comprehensive sets of observations from surface-based observing systems, and WMO plays an essential role in facilitating and coordinating the acquisition and international exchange of such observations.

1.1.4 The aim of the workshop was to develop a GBON concept, capturing the overarching design principles, along with target performance parameters for variables to be observed and for horizontal and temporal resolution.

1.1.5 The list of participants is given in [Appendix I](#Appendix_I).

**1.2 Adoption of the agenda**

The participants adopted the [Agenda](#AGENDA) for the meeting, which is reproduced at the beginning of this report.

**1.3 Working arrangements**

1.3.1 The participants agreed on working hours and adopted a tentative work plan for consideration of the individual Agenda Items.

1.3.2 Agenda Items 2-7 were considered and discussed in plenary during the first day. The second and third days the work was organized in two breakout groups. One group worked on the draft GBON concept, the other group on the list of specific GBON design parameters; in the final stage of the workshop these parameters were incorporated in the draft Concept that is reproduced in [Appendix II](#Appendix_II).

1. **RELEVANT DECISIONS FROM CBS-TECO-2018, CBS-MG, CGMS-46, AND EC-70**
   1. Dr L. P. Riishojgaard, PM/WIGOS, briefed the workshop on the guidance and recommendations received from CBS-MG and EC-70 regarding the implementation of GBON.
   2. Reflecting on early findings of the WIGOS Data Quality Monitoring System, regarding continued poor data coverage in many areas of the globe, EC-70 requested the Commission for Basic Systems (CBS) to develop an overarching design for the GBON to meet threshold requirements for Global Numerical Weather Prediction and Global Climate Monitoring (Analysis) as established by the Rolling Review of Requirements Process, taking into account the respective contributions of space-based and surface-based components of WIGOS.
   3. CBS will work with regional associations and the GCW Steering Group to design, establish and monitor their Regional Basic Observing Networks (RBONs) to conform to the over-arching GBON design.
   4. EC-70 requested ICG-WIGOS to develop relevant provisions for the Manual on WIGOS (WMO-No. 1160) regarding the implementation of the GBON and propose them to Cg-18 in 2019.
2. **WDQMS PILOT: CURRENT STATUS OF DATA SHARING FOR GLOBAL NWP**

3.1The workshop noted that global numerical weather prediction (GNWP) and climate reanalysis play an essential role as the backbone for all products and services provided by WMO Members to their constituencies, even for services provided at regional and local levels. Of the 14 application areas that are currently supported by the WMO Rolling Review of Requirements (RRR), all but one are thus in part or wholly dependent on GNWP input.

3.2 The open and unrestricted access to observational data from the entire global domain provided through the WMO Global Observing System (GOS) is critical for these applications. Lack of observational data in one or more areas of the globe are known to negatively impact the quality of the forecast and analysis products, not only in the area of missing data, but elsewhere on the globe as well. And yet monitoring statistics provided by the WIGOS Data Quality Monitoring System (WDQMS) show continued unsatisfactory availability of surface-based observational data coverage over many areas of the global domain.

3.3The workshop was advised that, following discussions of this issue at the CBS TECO in March 2018, the CBS Management Group decided to bring it to the attention of the Executive Council. In June EC-70 gave CBS the authority to proceed with the design of a Global Basic Observing Network (GBON), the primary aim of which would be to clarify the obligations of the WMO Members to provide critically needed observation data for near-real time international exchange at the global level. Today the observing networks are designed at the regional level, with very substantial inter-regional differences in data coverage as a result (more details are available in [NPW Pilot Project and Preliminary Results](http://www.wmo.int/pages/prog/www/wigos/documents/Tools/WDQMS_en.docx)).

1. **MEMBERS’ COMPLIANCE WITH MANUAL ON THE GLOBAL OBSERVING SYSTEM AND CBS RECOMMENDATIONS; RATIONALE FOR GBON**

4.1 Dr L. P. Riishojgaard provided the summary of information provided in [Members' Compliance with Manual on the GOS and CBS Recommendations; Rationale for GBON](http://www.wmo.int/pages/prog/www/WIGOS-WIS/meetings/GBON-2018/Item-3-4_WDQMS.pptx), which was submitted to the workshop.

1. **SCIENTIFIC BASIS FOR GBON DESIGN**

5.1 The workshop was briefed about the outcomes from the Sixth WMO Workshop on the impact of various observing systems on NWP, Shanghai 2016. Relevant IPET-OSDE recommendations were presented as well.

1. **REVIEW OF THE RBON CONCEPT AND DRAFT RBON PROVISIONS IN THE MANUAL ON WIGOS (WMO-No. 1160)**

6.1 R. Stringer, Chair WIGOS Editorial Board briefed the workshop on the existing draft RBON provisions in the Manual on WIGOS (WMO-No. 1160).

1. **GBON DESIGN**

7.1 The OSCAR observational requirements relevant to GBON were reviewed. Two key issues to be addressed by the GBON concept and provisions were identified: 1) areas of the world where observations required for NWP that exist but are not currently internationally exchanged), and 2) areas of the world with observational gaps (where no or not enough observations are currently made). In the former case, the GBON provisions will help clarify the obligation of the WMO Members to exchange their observations. In the latter case, the GBON provisions are expected to act as a driver for WMO’s involvement in internationally funded capacity development efforts aimed at strengthening observing systems.

1. **DRAFT GBON PROVISIONS IN THE MANUAL ON WIGOS**

8.1 It was decided that the GBON provisions to be included in the draft Manual for WIGOS will be based on the GBON Concept developed at the Workshop ([Appendix II](#Appendix_II)) and to delegate the drafting of the initial version of these provision to three of the Workshop participants, A. Rea, J. Dibbern and S. Goldstraw, with the help of the Secretariat and the WIGOS Editorial Board.

1. **REQUIREMENTS FROM APPLICATION AREAS OTHER THAN GLOBAL NWP AND CLIMATE MONITORING**

9.1 It was decided that in order to keep the GBON Concept focused and based on requirements that are indisputably global and of common interest to all WMO Members to not consider application areas other than Global NWP and climate monitoring (reanalysis) at this point.

1. **WAY FORWARD**

10.1 The Workshop agreed that even though Congress-18 was less than one year away, it would be important not to miss this opportunity to strengthen a vital element of WIGOS, and that the alternative of waiting potentially another full four-year cycle for the next opportunity for Congress to discuss this would be unacceptable. It was therefore agreed that communication to all PR’s and other stakeholders both inside and outside of WMO was critically important. The WMO Secretariat was requested to take the lead in developing the requisite communication material and to proactively seek venues where such communication could take place.

10.2 The workshop agreed on the need to develop the GBON Communication plan. This would cover the overall communication messages and methods to publicise the GBON concept with members in preparation for it being considered at. The Secretariat agreed to develop such a plan following the Workshop.

**11. CLOSURE OF THE SESSION**

The session closed on Wednesday, 25 July 2018, at 15:15 hours.

\_\_\_\_\_\_\_\_\_\_\_\_

**Appendix I**

**LIST OF PARTICIPANTS**

|  |  |
| --- | --- |
| **GBON; 23-25 July 2018 GENEVA**  **List of Participants** | |
| Anthony Rea  Co-Chair CBS/OPAG-IOS | Bureau of Meteorology, Australia  [anthony.rea@bom.gov.au](mailto:anthony.rea@bom.gov.au%20) |
| Jochen Dibbern  Co-Chair CBS/OPAG-IOS | Deutscher Wetterdienst, Germany  [Jochen.Dibbern@dwd.de](mailto:Jochen.Dibbern@dwd.de) |
| Erik Andersson  Chair, IPET-OSDE | ECMWF  [erik.andersson@ecmwf.int](mailto:erik.andersson@ecmwf.int) |
| Stefan Klink  Co-chair, IPET-OSDE | Deutscher Wetterdienst, Germany  [stefan.klink@dwd.de](mailto:stefan.klink@dwd.de) |
| Russell Stringer  Chair, ICG-WIGOS/WEdB | Australia  [russellmeteo@gmail.com](mailto:russellmeteo@gmail.com) |
| John Eyre | Met Office, UK  [john.eyre@metoffice.gov.uk](mailto:john.eyre@metoffice.gov.uk) |
| Stuart Goldstraw | Met Office, UK  [stuart.goldstraw@metoffice.gov.uk](mailto:stuart.goldstraw@metoffice.gov.uk) |
| Neil Jacobs | NOAA, US  [neil.jacobs@noaa.gov](mailto:neil.jacobs@noaa.gov) |
| Courtney Draggon (Ms) | NOAA, US  [courtney.draggon@noaa.gov](mailto:courtney.draggon@noaa.gov) |
| Sid A. Boukabara | NOAA, US  [sid.boukabara@noaa.gov](mailto:sid.boukabara@noaa.gov) |
| Seiyoung Park (Ms) | KMA, Republic of Korea  [sypark0@korea.kr](mailto:sypark0@korea.kr) |
| Yoshiaki Sato | JMA, Japan  [y-sato@met.kishou.go.jp](mailto:y-sato@met.kishou.go.jp) |
| Pei Chong (Ms) | CMA, China  [pcaoc@cma.gov.cn](mailto:pcaoc@cma.gov.cn) |
| Simon Pellerin | Environment Canada, Canada  [simon.pellerin@canada.ca](mailto:simon.pellerin@canada.ca) |
| Mariane DIOP-KANE (Ms) | [marianediopkane@gmail.com](mailto:marianediopkane@gmail.com) |

|  |  |
| --- | --- |
| **WMO SECRETARIAT** | |
| Fernando Belda  D/OBS | [fbelda@wmo.int](mailto:fbelda@wmo.int) |
| Lars Peter Riishojgaard  WIGOS Project Manager | [LRiishojgaard@wmo.int](mailto:LRiishojgaard@wmo.int) |
| Igor Zahumensky  WIGOS Project Officer | [izahumensky@wmo.int](mailto:izahumensky@wmo.int) |
| Luis Filipe Nunes  WIGOS Scientific Officer | [LFNunes@wmo.int](mailto:LFNunes@wmo.int) |
| Etienne Charpentier  C/OSD | [ECharpentier@wmo.int](mailto:ECharpentier@wmo.int) |
| Tim Oakley  GCOS Secretariat | [toakley@wmo.int](mailto:toakley@wmo.int) |
| Robert A. Varley  Special Advisor of SG | [robert.a.varley@gmail.com](mailto:robert.a.varley@gmail.com) |

**\_\_\_\_\_\_\_\_**

**Appendix II**

**THE GLOBAL BASIC OBSERVING NETWORK CONCEPT**

*Version 1.1, 13/09/2018*

1. **Preamble**

Global numerical weather prediction (GNWP) and climate reanalysis play an essential role as the backbone for all products and services provided by the NMHSs of the WMO Members to their constituencies, even at regional and local levels. Within the WMO Rolling Review of Requirements (RRR) process, nearly all 14 application areas currently listed have some level of dependency on GNWP and climate reanalysis.

These global application areas depend on access to globally consistent sets of observations provided by surface- and space-based observing systems.WMO facilitates, coordinates and monitors the collection and international exchange of such observations.

Preliminary reports from the WIGOS Data Quality Monitoring System (WDQMS) NWP pilot, show continued poor availability of surface-based observational data coverage over many areas of the global domain. This limits the ability of all WMO Members to provide weather and climate services to their constituencies.

In order to ensure that observational requirements for GNWP and climate reanalysis are met more effectively, a new approach is proposed, in which the basic surface-based observing network that is essential to support these applications is defined at the global level. This network is the Global Basic Observing Network, or GBON.

1. **Concept of Global Basic Observing Network (GBON)**

The GBON will be a subset of the surface-based subsystem of WIGOS, used in combination with the space-based subsystem and other surface-based observing systems of WIGOS, to contribute to meeting the requirements of GNWP, including reanalysis in support of climate monitoring. Design, execution and management of a GBON will be made in the context of the WIGOS through a global design process. GBON will respond to GNWP requirements that cannot currently be met, or fully met, by space-based systems.

GBON is the foundation upon which the Regional Basic Observing Networks (RBONs) are built to respond to requirements of a broader range of WMO application areas.

Note: The space-based component of WIGOS is defined by the CGMS Baseline, as included in the Manual on WIGOS.

* 1. **Key attributes of the GBON (not exclusive):**

GBON stations/platforms have to comply with the following:

1. Requirements for real-time and near-real-time data exchange at the global level;
2. Requirements for regular updates of WIGOS metadata in the Observing Systems Capability Analysis and Review tool (OSCAR);
3. Requirements for data exchange in defined WMO formats;
4. Requirements for complying with the WIGOS quality management according to the *Manual on WIGOS*;
5. Requirements for change management according to the *Manual on WIGOS*;

Note: GBON stations/platforms are not limited to those under the responsibility of the National Meteorological and Hydrological Services (NMHSs).

* 1. **Design, implementation and management of GBON**

Assuming that Congress-18 will adopt the governance structure in a form close to what was endorsed by EC-70, the new Commission for Observations, Infrastructure and Information Systems (COIIS) will be tasked to design and manage the GBON. Members and WMO partner organizations will implement the GBON. COIIS will also consider necessary capacity development actions.

The GBON will be designed starting from the technology-free requirements from the Rolling Review of Requirements, and it will employ available technologies that can help address these requirements. The design will take into account the cost-effectiveness of the various technologies, how they complement each other, and the contribution made by space-based observations.

The GBON design will be based on the specifications listed in the table below (see section 2.3), and the overall aim is to ensure that the GBON observations, together with satellite data and other sources of observations available, adequately address GNWP requirements.

COIIS will establish a consultative process to ensure that the design will be done in consultation with Members and WMO partner organizations responsible for observing systems contributing to GBON.

The proposal for GBON, including an action plan for phased implementation and filling identified gaps, will be submitted to Congress for consideration and adoption through a resolution. Congress will request Members, and invite WMO partner organizations to implement the GBON design.

In response to the GBON design detailed in the Congress Resolution, Members and WMO partner organizations will commit specific observing stations/platforms with specific observing programmes (variables and schedules) to be part of the GBON, or take steps nationally or regionally to develop capacity as needed.

* 1. **Criteria for the selection of stations/platforms into GBON**

In establishing the GBON, the emphasis is put on a set of specific variables that currently depend on observations provided by surface-based systems.

Candidate GBON stations/platforms will be selected according to their availability for global data exchange and their expected contribution to forecast skill and/or analysis accuracy.

The specifications for GBON are as follows:

|  |  |  |
| --- | --- | --- |
| **Type of Station** | **Parameters measured** | **Required commitment by Members** |
| Surface – Land  (manual or AWS) | Surface pressure; near-surface air temperature, humidity and wind; precipitation; snow1 | - SHALL implement - 500 km, hourly2;  - SHOULD implement - 100 km, hourly |
| Surface - ocean  (drifting buoys, ships) | Surface pressure, sea surface temperature | - SHOULD implement - 500 km, hourly, or better |
| Upper air – land  (radiosonde, profiler, aircraft) | Temperature, humidity and wind profile | - SHALL implement - radiosonde - 500 km, 12-hourly  - vertical resolution - 100 m or better  - top - 30 hPa or better  - SHOULD - implement complementary observing systems  - radiosonde, aircraft, profiler  - up to density of 50 km, hourly  – radiosonde to 10 hPa, 1000 km, 24-hourly  - aircraft - ascent/descent, vertical res - 300 m or better;  - aircraft - flight level, horizontal res - 100 km or better |
| Upper air – ocean  (radiosonde, aircraft) |  | - SHOULD implement - radiosonde, 500km, 12-hourly  - aircraft - flight level - 100 km or better |

Notes:

1 – observations of snow depth shall include observations of no snow; observing cycle for snow depth may be daily

2 – recognizing that manual observations are taken less often, the requirement for hourly observations is waived for manual stations and is replaced by “as frequently as possible, up to hourly”

Additionally, for all GBON platforms listed above, Members SHALL disseminate what is observed (and available for dissemination) up to a resolution of 15 km horizontally and hourly temporally (the current *goal* requirements for Global NWP).

* 1. **Monitoring of GBON design and implementation.**

The responsibility for defining the tasks necessary for monitoring the implementation and functioning of GBON monitoring falls to COIIS. The Regional Associations in collaboration with COIIS will coordinate the actual monitoring activities *(see note below).*

The monitoring is expected to include the following functions:

***Progress of implementation***

Progress with regard to GBON implementation and commitments of Members and WMO partner organizations to GBON will be monitored.

***Effectiveness of the design***

GBON will be routinely monitored globally to assess adequacy and effectiveness of the design of GBON to address GNWP requirements.

***Monitoring and incident management***

Incident management and some monitoring functions will be coordinated through WDQMS.

*Note: In the new WMO Governance Structure to be proposed to Congress-18, all Regional Associations will have similar working structures, including Regional Working Groups on Observations, Infrastructure and Telecommunication (name TBC). COIIS will form a number of Standing Committees, including a Standing Committee on Observing Networks (name TBC). The structure calls for a set number (2 or 3, TBD) of experts from each of the Regional Working Groups to be matrixed into the appropriate TC Standing Committees in order to ensure (i) strong involvement of all regions in Technical Commission work, (ii) close and direct coordination between the work of Regional Associations and Technical Commissions by using the same experts.*

1. **Further background and reference material for the Global Basic Observing Network concept**

…

* NWP Obs. Impact Workshop reports
* EGOS-IP
* Manual on WIGOS, incl. OND Principles

…

\_\_\_\_\_\_\_\_\_\_