WORLD METEOROLOGICAL ORGANIZATION

EXECUTIVE COUNCIL WORKING GROUP ON THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM AND THE WMO INFORMATION SYSTEM

Fourth Session

Geneva, Switzerland, 10-11 February 2011

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).

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CONTENTS

AGENDA

1. ORGANIZATION OF THE SESSION
2. REVIEW OF GUIDANCE AND RECOMMENDATIONS ADOPTED BY EC-LXII
3. REPORT OF SUB-GROUP ON WIGOS
4. REPORT ON THE INTEGRATION BETWEEN THE WMO OBSERVING SYSTEMS INCLUDING ATTACHMENTS (WDIP, CONOPS, WDIS AND WIP)
5. PROGRESS IN WIS IMPLEMENTATION AND COORDINATION WITH WIGOS
6. RECOMMENDATIONS FOR Cg-XVI
7. ANY OTHER BUSINESS
8. CLOSURE OF THE SESSION

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EXECUTIVE SUMMARY

The fourth session of the Executive Council Working Group on the WMO Integrated Global Observing System and the WMO Information System (EC-WG/WIGOS-WIS-4) was held at the WMO Secretariat in Geneva, Switzerland, from 10 to 11 February 2011. The session was chaired by Prof A. D. Moura (Brazil), Third Vice-President of WMO.

EC-WG/WIGOS-WIS reviewed and endorsed the following WIGOS documents to be submitted to the sixteenth Congress (Cg-XVI):

(a) Report on the Integration between the WMO Observing Systems (Appendix II);

(b) WIGOS Test of Concept Development and Implementation Plan (WDIP) (Appendix III);

(c) WIGOS Concept of Operations (CONOPS) (Appendix IV);

(d) WIGOS Development and Implementation Strategy (WDIS) (Appendix V).

Furthermore, EC-WG/WIGOS-WIS-4 formulated its recommendations on the WIGOS implementation in the form of Draft Resolution 11.3/1 (Cg-XVI) – Implementation of the WMO Integrated Global Observing System (WIGOS) (Appendix VII).

When discussing the individual Agenda Items, particular attention was given to pre-Congress actions, on the enhancement of communication on WIGOS matters.

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GENERAL SUMMARY

1. ORGANIZATION OF THE SESSION

1.1 Opening of the meeting

1.1.1 The fourth session of the Executive Council Working Group on the WMO Integrated Global Observing System and the WMO Information System (EC-WG/WIGOS-WIS) was opened by its Chair, Prof A. D. Moura, Third Vice-President of WMO, at 09:00 hours on Thursday, 10 February 2011, at the WMO Headquarters in Geneva, Switzerland.

1.1.2 Michel Jarraud, the Secretary-General, welcomed the participants to Geneva. He underlined the importance of this meeting to finalize and endorse WIGOS documentation which should convey a strong message to the forthcoming Congress in May on the perspectives of WIGOS implementation. He stressed that in accordance with the decision of EC-LXII, WIGOS was determined as one of the WMO priorities for the next financial period. He also underlined that the meeting should address, inter alia, WIGOS unique opportunities to contribute to the Global Framework for Climate Services (GFCS).

1.1.3 The list of participants is given in Appendix I.

1.2 Adoption of the agenda

EC-WG/WIGOS-WIS adopted the Agenda for the meeting, which is reproduced at the beginning of this report.

1.3 Working arrangements

EC-WG/WIGOS-WIS agreed on its working hours and adopted a tentative work plan to consider various Agenda Items.

2. REVIEW OF GUIDANCE AND RECOMMENDATIONS ADOPTED BY EC-LXII

2.1 EC-WG/WIGOS-WIS-4 reviewed the guidance and recommendations by EC-LXII (Geneva, June 2010) on the further development and implementation of WIGOS.

3. REPORT OF SUB-GROUP ON WIGOS

3.1 EC-WG/WIGOS-WIS noted with appreciation the Report of Chair, Subgroup on WIGOS on the outcomes and deliverables of SG-WIGOS-3 (Geneva, 12 - 14 October 2010), including the final report from the session, that provided valuable proposals and recommendations on the further development and implementation of WIGOS.

3.2 EC-WG/WIGOS-WIS agreed with conclusions of SG-WIGOS-3 and expressed the satisfaction with the progress achieved in the WIGOS concept development. It reiterated the importance of active engagement of all WMO Members and Regions for a successful implementation of WIGOS. In this context, a need for sufficient resources to support activities at national and regional levels was stressed. EC-WG/WIGOS-WIS agreed that in terms of practical guidance, an early development of the Manual on WIGOS will be critical, especially for NMHSs of LDCs, LLDCs and SIDS; it will enable them to estimate resources (capacity-building activities and funds) needed for the WIGOS implementation at national level. In this regard, EC-WG underlined a crucial importance of clear articulation and effective communication of benefits that WIGOS will bring to Members.

3.3 EC-WG/WIGOS-WIS agreed that prior and during Congress, the highest attention should be paid to the enhancement of communication activities to well advise Permanent Representatives of Countries (PRs) on WIGOS matters, emphasizing benefits WIGOS will bring them. Communications should clearly indicate the importance of WIGOS and WIS for essential improvement and

enhancement of services provided by Members through reasonable initial investment related to the WIGOS implementation.

3.4 In this regard, EC-WG/WIGOS-WIS underlined the need for a WIGOS information booth and side event to be organized during Congress to facilitate and support in-session discussions on WIGOS matters.

4. REPORT ON THE INTEGRATION BETWEEN THE WMO OBSERVING SYSTEMS INCLUDING ATTACHMENTS (WDIP, CONOPS, WDIS AND WIP)

4.1 EC-WG/WIGOS-WIS reviewed the draft Report on the Integration of the WMO Observing Systems and endorsed its final version to be submitted to Cg-XVI (Appendix II).

4.2 EC-WG/WIGOS-WIS further reviewed and endorsed the following documents to be submitted to Congress: a) a concise version of the WIGOS Development and Implementation Plan (WDIP) (Appendix III); b) the WIGOS Concept of Operations (CONOPS) (Appendix IV); and WIGOS Development and Implementation Strategy (WDIS) (Appendix V).

4.3 EC-WG/WIGOS-WIS was briefed on the development of a draft WIGOS Implementation Plan (WIP) (Appendix VI), an initial draft Manual on WIGOS and a draft layout of CONOPS (Annex to the paragraph) related to the real WIGOS functional architecture to be elaborated urgently after Cg-XVI as a main reference for the WIP. EC-WG/WIGOS-WIS welcomed this initiative of the Secretariat and appreciated the work done. It noted that further guidance and specific recommendations on the completion of these three documents will be given in the light of Cg-XVI decisions.

5. PROGRESS IN WIS IMPLEMENTATION AND COORDINATION WITH WIGOS

5.1 EC-WG/WIGOS-WIS welcomed the report from the Chair of ICG-WIS. It noted that the implementation of WIS was on schedule for making the new functions of WIS operational following Congress XVI. It noted that there are three GISCs and 15 DCPCs in pre-operational readiness, with many others to go operational in the following 12 months.

5.2 EC-WG/WIGOS-WIS noted that in addition to the existing GTS functionality, the communication and network components of the GTS under the Improved Main Telecommunication Network project and their evolution in readiness for WIS were also completed.

5.3 EC-WG/WIGOS-WIS highlighted that the WIGOS Pilot and Demonstration projects showed that Members contributing to the development of WIGOS had a good grasp of the principles of WIS and its important role as the interoperable layer of WIGOS. Furthermore, the meeting was pleased that the Projects also confirmed that the WIS development and implementation was well coordinated with WIGOS needs.

5.4 EC-WG/WIGOS-WIS noted a good momentum in the WIS implementation and stressed that it should be maintained; it also recommended that WIGOS and WIS should be presented together to enable Members to understand them appropriately.

5.5 EC-WG/WIGOS-WIS recognized that WIS was now in a critical stage of implementation and that although the role of the initial ICG-WIS had been completed effectively, there still remains a need for high level coordination between TCs as well as RAs for the next two years.

6. RECOMMENDATIONS FOR Cg-XVI

6.1 EC-WG/WIGOS-WIS reviewed Draft Resolution 11.3/1 (Cg-XVI) - Implementation of the WMO Integrated Global Observing System (WIGOS). The version to be submitted to Congress is

reproduced in Appendix VII. In this regard, the Secretariat was requested to ensure consistency of other documents on WIGOS submitted to Cg-XVI with the Draft Resolution.

7. ANY OTHER BUSINESS

7.1 EC-WG/WIGOS-WIS was briefed on the proposal for "WIGOS Marketing" presented by Mr. W. Kusch. It deals with communication activities before and during Congress, including preparation of the WIGOS brochure, organization of a WIGOS information booth and side event at Cg-XVI.

7.2 EC-WG/WIGOS-WIS agreed that a current version of the WIGOS brochure should be provided to Chair, EC-WG/WIGOS-WIS by 18 February 2011 for his final comments. It was further agreed that Chair will circulate the draft Brochure among selected PRs with cover letter enlightening how WIGOS can help NMHSs in the future to meet their requirements in a cost-effective manner.

7.3 EC-WG/WIGOS-WIS noted with appreciation an information paper "WIGOS – A member Perspective" by Dr S.L. Barrell. It further agreed that a presentation based on this paper should be made by S. Barrell at the WIGOS side event during Cg-XVI.

7.4 Two additional topics were presented at the session: Activities of the WMO EC Panel of Experts on Polar Observations, Research and Services (EC-PORS), and Climate Monitoring from Space - A Call for an International Space-based Architecture. EC-WG/WIGOS-WIS welcomed these presentations and noted a very positive experience in establishing close links with WIGOS development.

8. CLOSURE OF THE SESSION

8.1 The session closed on Friday, 11 February 2011, at 16:45 hours.

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Appendix I

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Appendix II

COMPREHENSIVE REPORT ON THE INTEGRATION BETWEEN THE WMO OBSERVING SYSTEMS

Background

1. The Fifteenth World Meteorological Congress (Geneva, May 2007) recognized the WMO Integrated Global Observing System (WIGOS) as a major component of the WMO second cycle of results-based management to address identified global societal needs. It requested that the development of WIGOS proceed concurrently with the planning and implementation of the WMO Information System (WIS). The combination of both efforts would allow for an integrated WMO end-to-end system of systems designed to improve Members' capability to effectively provide a wide range of high quality services and to better respond to all WMO Programmes requirements.

2. Congress also underlined that an integrated global observing system supported by an interoperable information system will be essential for realizing the socio-economic benefits derived from a wide range of products and services related to WMO's core competencies of weather, water, climate, and disaster risk reduction. WIGOS will contribute to all WMO Expected Results of the 2012-2015 Strategic Plan and in particular, will deliver Expected Result 4, "Enhanced capabilities of Members to access, develop, implement and use integrated and interoperable surface-based and space-based systems for weather, climate and hydrological observations, as well as related environmental observations, based on world standards set by WMO and partner organizations". Congress by its Resolution 30 (Cg-XV) requested the Executive Council to submit a comprehensive report on the integration between the WMO observing systems to Sixteenth Congress.

Enabling NMHSs to Improve Services

3. Observations of the atmosphere and the related environment form the foundation for the delivery of weather, climate, water and related environmental services by NMHSs. These observations are also essential for conducting research to improve services, assessing changes in the climate system, and for developing and operating systems in weather and climate dependent sectors such as agriculture, water, transport, and energy, among others, to support efforts of communities to reduce disaster risks and adapt to climate variability and change. WIGOS will build on and add value to the WMO's existing observing systems by coordinating their efforts, addressing shortcomings, and supporting their interoperability, while satisfying the observational requirements of WMO and WMO co-sponsored Programmes in a cost-effective manner. With the development of the WIGOS and WIS, the NMHSs will have the benefit of access to more and better data and product to provide improved services and more effective ways to disseminate information and products to users.

Benefits and Resources

4. WIGOS Implementation activities will require additional resources as well as a long-term commitment of WMO Members, enhanced international cooperation, sustained technological and infrastructure capacity building, and financial support for developing and least developed countries. Implementation of WIGOS will provide efficiencies and increased effectiveness in meeting observing requirements.

Governance

6. Cg-XV has determined that in implementing WIGOS, it will be necessary to ensure that the governance and support activities are aligned with the strategic thrusts of WMO, including results-based management. Furthermore, the development of an effective and efficient system of governance will require adequate scientific and technical advisory mechanisms to develop, monitor and evaluate the WIGOS process. Congress also agreed that planning and implementation of the WIGOS

integration process should proceed in phases defined by the WMO Executive Council in order to assure oversight, review and direction. Following this guidance, Executive Council through its Resolution 3 (EC-LIX) established the Executive Council Working Group on the WMO Integrated Global Observing System and the WMO Information System (EC-WG/WIGOS-WIS) to steer and monitor WIGOS activities and to coordinate them with the planning and development of WIS. Acting accordingly, the EC-WG/WIGOS-WIS at its first session (Geneva, December 2007) reviewed the guidance and recommendations given by Cg-XV and EC-LIX towards implementation of the WIGOS concept, developed its work programme and established a Subgroup on WIGOS (SG WIGOS), as authorized by EC-LIX.

7. Cg-XV also emphasized that the integration is a long-term complex undertaking, which will comprise policy as well as technical issues and will require the full support of all Members to be successful. The integration within WIGOS will actively involve, and eventually depend on the expertise and inputs from the technical commissions (TCs) and regional associations (RAs). It is also recognized that close and effective collaboration with several of WMO partner organizations and co-sponsors of observing systems will be one of the key elements of this process.

8. Cg-XV also indicated that to accomplish successful development and implementation of the WIGOS concept, adjustments of the structure and function of WMO, including the WMO Programme structure, roles, responsibilities, terms of reference and working arrangements of technical commissions and regional associations, the WMO Technical Regulations, and the WMO Secretariat will have to be made. Accordingly, appropriate steps will need to be taken to ensure that the integration process is incorporated in the work programmes and implementation plans of these entities.

Strategic Roadmap

9. Strategic targets of WIGOS, as formulated by Cg-XV and the sessions of the Executive Council, formed the basis for development of the overarching WIGOS Test of Concept Development and Implementation Plan (WDIP) by the EC-WG/WIGOS-WIS, which identified the WIGOS integration activities during the four-year period 2008-2011. WDIP and its subsequent annual revisions continued to be a principal document informing technical commissions, regional associations and the steering committees of the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS) and the World Climate and research Programme (WCRP), on the progress in the WIGOS planning activities and encouraged them to provide their inputs into the integration process.

10. The WDIP contained 49 specific action items to be accomplished by the time of Cg-XVI (May 2011). They referred to the following phases of WIGOS development and implementation:

- Preparatory Phase: December 2006 - Cg-XV (May 2007)
- Test of Concept, Phase I: Cg-XV (May 2007) – EC-LX (June 2008)
- Test of Concept, Phase II: EC-LX (June 2008) – EC-LXI (June 2009)
- Test of Concept, Phase III: EC-LXI (June 2009) – EC-LXII (June 2010)
- Test of Concept, Phase IV: EC-XII (June 2010) – Cg-VI (May 2011)

11. WDIP identified a sequence of meetings of the EC-WG/WIGOS-WIS and its Subgroup on WIGOS with subsequent reports to the annual EC sessions, activities related to the implementation of WIGOS Pilot and Demonstration projects; it addressed revisions of the WMO Programme structure, the terms of reference of the technical commissions, and WMO Secretariat budgetary, personnel and organizational implications. WDIP also identified the need to revise the current WMO regulatory material reflecting WIGOS development and related technical guidance.

12. Thanks to the efforts by Members, regional associations and technical commissions, partner organizations, coordinated with the Secretariat, planned activities for relevant phases have been timely initiated and successfully accomplished. WDIP was regularly updated and published at: http://www.wmo.int/pages/prog/www/wigos/index_en.html. Appendix D contained a concise version of WDIP.

WIGOS Concept of Operations (CONOPS)

13. EC-LX (June, 2008) stressed that there was a need to have in detail conceptual aspects of WIGOS operations and expected benefits of integration to make them more clear and transparent for all NMHSs, partner organizations and also for policy makers. Acting accordingly, the Secretariat in close cooperation with the EC-WG/WIGOS-WIS developed and kept updated on a regular basis the WIGOS Concept of Operations (CONOPS) which originally contained goals, objectives, major characteristics, operational framework, data policy and benefits of WIGOS. Based on the feedbacks from EC-WG/WIGOS-WIS and its Subgroup, recommendations of the Executive Council, significant change of the original document structure and enlargement of its content was done, taking into account existing international standards and national practices. The current version of CONOPS contains streamlined description and recommendations related to all principal aspects of planning and implementation of WIGOS giving, inter-alia, special consideration to the following:

- WIGOS requirements and expectations;
- Detailed conceptual description of WIGOS operations;
- Roles, responsibilities and mandates of stakeholders;
- Relationship, intersection and boundaries of WIGOS with the co-sponsored observing systems;
- Vision for an operational WIGOS;
- WIGOS data policy;
- Impacts and Implications.

14. EC-LXI noted with appreciation the progress in the refinement of the CONOPS and its content. The current version of CONOPS (*version 5.1*) is published at http://www.wmo.int/pages/prog/www/wigos/index_en.html (see also Appendix E).

WIGOS Development and Implementation Strategy (WDIS)

15. EC-LXI (June, 2009) requested that a WIGOS Development and Implementation Strategy (WDIS) should be developed to describe steps that WMO and its partners would follow to improve governance, management, and integration of observing systems. The importance of such a document was underlined in the process of implementation of WIGOS projects. The initial version of WDIS was developed by the Secretariat for EC-LXII in collaboration with all concerned. WDIS contains description of major strategic components of WIGOS development and implementation, including integrated governance, data delivery and information services through WIS, quality management and standardization, optimization of observing systems and capacity building. It also describes WIGOS implementation management, specifying deliverables and milestones, roles and responsibilities and resources needed. The updated version of WDIS (*version 1.1*) is published at http://www.wmo.int/pages/prog/www/wigos/index_en.html (see also Appendix F).

WIGOS Implementation Plan (WIP)

16. Following EC-LXII, a skeletal WIGOS Implementation Plan was formulated utilizing WDIP, CONOPS and WDIS. Between Cg-XVI and Cg-XVII, a complete WIGOS Implementation Plan (WIP) will be developed. The updated version of the skeletal WIP (*version 0.3*) is available at http://www.wmo.int/pages/prog/www/wigos/index_en.html.

WIGOS Projects and Lessons Learned

17. Following the guidance given by Congress and the Executive Council, during the WIGOS Test of Concept phase (2007-2011), the WMO technical commissions, regional associations and Secretariat explored the concept of WIGOS through a series of Pilot Projects (PPs) (by the technical commissions and partner organizations) and Demonstration Projects (DPs) (by Members and the regional associations).

Pilot Projects

18. As recommended by Cg-XV, the following five Pilot Projects were initiated by relevant technical commissions:

- Pilot Project I: Improvement of Dissemination of Ozone (total column, profiles and surface) and Aerosol observations through the WIS;
- Pilot Project II: Hydrological Applications Runoff Network (later changed to Integration of Southern Africa Developing Community Hydrological Cycle Observing System (SADC-HYCOS) and the Flash Flood Guidance System (FFGS);
- Pilot Project III: Integration of AMDAR into WIGOS;
- Pilot Project IV: Elaboration of the underpinning/crosscutting role and responsibilities of the Instruments and Methods of Observation Programme in the context of WIGOS;
- Pilot Project V: Integration of Marine Meteorological and other appropriate Oceanographic Observations into the WMO Integrated Global Observing System;

Later, during the WIGOS Test of Concept Phase, the following two new projects were initiated:

- Pilot Project VI: Global Space-based Intercalibration System as a joint initiative of WMO and the Coordination Group for Meteorological Satellites, by WMO Satellite Programme in coordination with CGMS, and
- Pilot Project VII: Project for the implementation of the GCOS Reference Upper-Air Network, by GCOS.

19. Pilot Projects played an essential role in addressing major issues of the integration process: testing the WIGOS concept, identifying problem areas, emphasizing the role and contributions to be made by the technical commissions and relevant partners in applying the WIGOS concept to integration within a system of systems framework, and contributing to the development of the WIGOS Development and Implementation Plan.

Demonstration Projects

20. In accordance with recommendations by EC-LX to support the involvement of NMHSs and regional associations in the implementation of the WIGOS concept and to help Members to understand and fully explore WIGOS, several demonstration projects in the selected WMO Member Countries were initiated. At least one 'test-bed' Demonstration Project was identified within each Regional Association with various levels of progress. They were as follows: Kenya, Morocco and Namibia (RA I), Republic of Korea (RA II), Brazil (RA III), United States of America (RA IV), Australia (RA V) and the Russian Federation (RA VI). Recently, based on the decision of the XV session of RA VI (September 2009), RA VI-MG decided to establish a Task Team on the redesign of the RA-VI basic ground-based observing network and supported to run this as a new WIGOS Demonstration Project.

21. Feedback and lessons learned from these NMHSs were beneficial for WMO Members and partners in understanding expectations from the WIGOS concept at national and regional levels, including significant capacity building possibilities. The status of implementation of WIGOS Pilot and Demonstration Projects has been regularly updated on the WIGOS Web page and includes lessons learned from each project. These can be found at http://www.wmo.int/pages/prog/www/wigos/index_en.html.

22. The survey of Pilot and Demonstration projects, regularly carried out by the Secretariat clearly showed that they cover key aspects of integration of observing systems, as well as a wide range of issues including national and inter-agency cooperation and partnership, consideration of not only weather-related observations, resources and funding, data exchange and metadata management, instrument standards, quality management, network optimization and use of new technologies.

23. While WIGOS projects are at varying stages of implementation, lessons learned already underlined the necessity for the following priority actions:

- In addition to WDIP and CONOPS, to develop other WIGOS guidance and regulatory material in accordance with existing standards. Highest priority should be given to the development of WIGOS Manual, which will identify rules and procedures to be followed within WIGOS;
- Finalize revision the terms of reference of regional associations and technical commissions, to assume new tasks related to WIGOS, recognizing CBS leadership and CIMO cross-cutting role;
- Negotiate with WMO partners of co-sponsored observing systems to identify their role and responsibilities in future WIGOS development, concluding/revising MOU and other legally binding documents;
- Develop a comprehensive WIGOS capacity building strategy in each WMO Region which would comprise organization of workshops and seminars, visits of experts, training support and technology transfer;
- Develop a communication and outreach strategy as indicated by WDIS;
- Continue implementation of WIGOS PPs and DPs, using simple evaluation criteria for their assessment;
- Prioritize the WIGOS work plan taking into account available resources.

24. The second session of EC-WG/WIGOS-WIS underlined that WIGOS Projects would provide a valuable learning experience which could validate approaches to integration, identify problematic areas, help to understand the benefits and provide clarification of more effective ways forward. Evaluation of the lessons learned could provide valuable feedback for the WIGOS planning and implementation, for the continuing development of CONOPS, WDIS and other documentation. As regards the development of new projects, EC-WG/WIGOS-WIS recommended that WIGOS activities undertaken by TCs, RAs and Member countries should be welcomed and encouraged as much as possible, regardless whether they are formally adopted as WIGOS projects, especially when generously sponsored and resourced by TCs, RAs, WMO Members or partners.

Guidelines on WIGOS related activities to be implemented by Members

25. Cg-XV underlined that Members will be the key beneficiaries of WIGOS. Moreover, in order to commence efforts towards achieving full WIGOS operations, Members along with the WMO Council, Regional Associations, Technical Commissions and the Secretariat are considered to have essential roles in this process and should assume certain responsibilities. Based on the lessons learned from WIGOS Demonstration Projects, there was a need expressed by some Members to have a concise guideline to facilitate implementation of WIGOS at the national level. Following the request of EC-LXI, the initial draft entitled “Guidelines on WIGOS related activities to be implemented by Members” was developed by the Secretariat in coordination with EC-WG/WIGOS-WIS and its Subgroup. The Guidelines include a short description of national WIGOS Project Initiation, Planning, Execution, Closure phases and provide relevant links with WIGOS Demonstration Projects. Current version of Guidelines (Version 1.0) is published at http://www.wmo.int/pages/prog/www/wigos/index_en.html.

Relationship to other Observing Systems

26. Cg-XV agreed that WIGOS integration would actively involve and eventually depend on inputs from WMO regional associations, technical commissions and the Steering Committees of GCOS, GOOS, GTOS and WCRP. It underlined that integration process should ensure the continued partnership and participation of the bodies responsible for observing systems. Direct involvement of WMO partners in the implementation of the WIGOS initiative has been accomplished through their representation in the WIGOS governing and working bodies (EC-WG/WIGOS-WIS and SG-WIGOS), and more extensive coordination and exchange of relevant documents and information between the Secretariats.

27. GCOS is a joint undertaking of the WMO, IOC of UNESCO, UNEP, and ICSU. Its goal is to provide comprehensive information on the total climate system, involving a multidisciplinary range of physical, chemical and biological properties, and atmospheric, oceanic, hydrological, cryospheric and terrestrial processes. It is built on the WMO Integrated Global Observing System (WIGOS), the IOC-WMO-UNEP-ICSU Global Ocean Observing System (GOOS), the FAO-UNEP-UNESCO-ICSU Global

Terrestrial Observing System (GTOS) and a number of other domain-based and cross-domain research and operational observing systems. It includes both in situ and remote sensing components, with its space based components coordinated by the Committee on Earth Observation Satellites (CEOS) and the Coordination Group for Meteorological Satellites (CGMS). GCOS is intended to meet the full range of national and international requirements for climate and climate-related observations. As a system of climate-relevant observing systems, it constitutes, in aggregate, the climate observing component of the Global Earth Observation System of Systems (GEOSS).

28. GOOS has substantial experience and success in planning of observational strategies and developing the international governance structures required to facilitate multi-national ownership and development of the ocean observing system. The most important challenge now facing GOOS is to complete and sustain an integrated global system with clear user benefits. GOOS identified that by participating in WIGOS this goal could be more readily achieved than would otherwise be the case. At the same time, substantial challenges remain. GOOS must increase research community contribution to and benefit from the system and improve and enhance accounting of governmental commitments to the system. Another challenge is to fill geographic and thematic gaps e.g. in developing regional systems in the Arctic and Southern Oceans and by transitioning pilot projects into fully operational components. GOOS hopes that WIGOS will help tackle some of these key challenges.

29. GTOS is contributing to a framework approach for the standardization of Essential Climate Variables (ECVs) in the terrestrial domain. In the context of WIGOS, GTOS recognizes the need for improved observations in terms of spatial distribution, frequency and quality built around standards and reporting guidelines which underpin the long-term meteorological and hydrological records. It identified some issues of key concern to GTOS related to the adequacy of data from satellite and in-situ systems, data accessibility, standardization, viability and sustainability of systems and data centres participating in WIGOS.

30. The WCRP Observation and Assimilation Panel (WOAP) deals with crosscutting issues related to the analysis and assimilation of global observations for climate studies from a research perspective on behalf of WCRP and GCOS. Future needs for observation and analyses identified by WOAP that relate to WIGOS include: observations from in-situ and from space that satisfy the climate observing principles; a performance tracking system; development and improvement of climate data records; the ingest, archival, stewardship of data, data management; access to data; the analysis and re-analysis of the observations and derivation of products, and data assimilation and model initialization. Many of these needs will be met through WIGOS and WIS. WOAP can help in improving communication and coordination in this area on behalf of WCRP and its Projects.

31. GEOSS is a coordinating and integrating framework of Earth observing and information systems, contributed on a voluntary basis by Members and Participating Organizations of the intergovernmental Group on Earth Observations (GEO). As might be expected, WIGOS and WIS are major WMO contributions to GEOSS. The WIGOS Development and Implementation Strategy, which stresses on the framework multi-disciplinary approach, further clarifies relationships and interactions of WIGOS with GEOSS.

32. In addition to activities mentioned above, there is a need to establish closer cooperation in the WIGOS context with existing national/regional initiatives such as EUMETNET, US IOOS, France/Coriolis.

Relationship with WMO Information System (WIS)

33. CONOPS and WDIS describe the role of WIS in WIGOS implementation. Along with essential functions to support the collection and sharing of observations and products, WIS will facilitate the WIGOS support for Disaster Risk Reduction (DRR) activities and the evolving requirements and needs of the Global Framework for Climate Services (GFCS). The WIGOS Pilot Projects, such as the JCOMM/IODE Ocean Data Portal, have shown the effectiveness of WIS as the core interoperability layer of WIGOS for information exchange and discovery. Demonstration projects have shown that, in addition to providing the collection and sharing of data within WMO observing systems, WIS can facilitate the movement of data between otherwise independent observing systems. WIS also provides

practices and standards for more effective data management and representation. Data management includes the generation, collection, and management of WIS metadata about observations and products required to support discovery, access and retrieval services. The Projects also highlight the need for the ongoing support to the creation and maintenance of the WMO Volume A (WMO-No. 9) and the creation of accessible station history records. Discovery metadata, including links to more detailed information about the observing site, practices and procedures, is essential to ensuring observational data and products within WIGOS meet the stringent traceability and quality requirements of special users such as climate scientists.

Rolling Review of Requirements (RRR) Process

34. To ensure continuous review of the requirements placed on the current observing systems and to have the capability to effectively adjust and respond to evolving user needs, WIGOS will be using the same RRR process as currently specified for the Global Observing System (GOS) in the Manual on the Global Observing System (WMO-No. 544). WDIP, CONOPS and WDIS provide details on the application of the RRR process in the WIGOS implementation. A wide range of applications within WMO Programmes have already been addressed through the RRR process. The role of regional associations and technical commissions will be indispensable in the overall process. Both user requirements and observing system capabilities, complemented by Statements of Guidance (SOG), are collated in a comprehensive, systematic and quantitative way in the WMO/CEOS database, which is accessible at: http://www.wmo.int/pages/prog/sat/Databases.html.

Technical Regulations

35. EC-WG/WIGOS-WIS recognized that WMO technical regulations must be revised to document the structure and requirements of WIGOS, adequately reflecting all the component systems. It is foreseen that upon the approval by Cg-XVI, the WIGOS Implementation Plan (WIP) will include the development of the Manual on WIGOS as a priority activity. WIGOS documentation will be a key deliverable in the period 2011-2015.

Priority activities for the future

36. WDIS and CONOPS accumulated lessons learned from the WIGOS Test of Concept phase and provide a comprehensive outlook and guidance on the future WIGOS implementation. The priority activities for the subsequent WIGOS implementation as specified in these documents are summarized below.

System evolution

37. Scientific and technological advances will be a crucial factor leading to improvement in sensors and system capabilities to withstand severe climate and environmental conditions and to improvements in sensor capability to accurately measure the whole range of meteorological, climatological, hydrological and environmental variables with high accuracy and repeatability. Progress in technology will continue to provide a basis for further improvements in the reliability and quality of observations, thus more fully satisfying user needs. Based on the above, within WIGOS, the following areas need to be addressed: Standardization, Automation, Testing, and Networking.

Development of the WIGOS Databases

38. As specified in CONOPS, the development of two WIGOS Databases (DB), i.e. the WIGOS Operational DB and the WIGOS Standardization DB as critical WIGOS support tools, will be crucial for the success of the WIGOS.

Quality Management, including Monitoring

39. Meeting the quality requirements and expectations of users will be critical to the success of WIGOS. This will require an in-depth examination of current practices used by WMO observing programmes, specific mission-related requirements that are already in place, and available

technological opportunities. It will also be important to review the quality not only of the deliverables produced by WIGOS but also of the management processes involved. WIGOS should embrace QMF procedures to ensure that observations, records and reports on weather, water, climate and other environmental resources, operational forecasts, warning services and related information are of identified quality. This will improve international exchange through the WMO coordinated systems and in compliance with relevant joint standards agreed upon with other international organizations.

Standardization

40. As specified in CONOPS, a principal requirement for integration is the standardization in three key areas: Instruments and Methods of Observation; WIS information infrastructure; Quality management framework. As part of the implementation strategy, a successful WIGOS standardization process will have to adequately address the differences and inconsistencies in current technical specifications, data acquisition and management systems used by individual NMHSs and partner organizations before national and international observing systems can be regarded as truly integrated.

Planning, Optimizing and Monitoring of Observing Systems

41. A coordinated planning, based on the RRR process (see section 30 above) also has a great potential to enhance observing system capabilities and to increase cost-effectiveness of observing efforts and investments. This process, conducted with close involvement of both the operational and research communities, should result in Statements of Guidance that can be either specific to each constituent observing system or commonly applicable to all. The coordinated planning of the evolution and enhancement of observing systems in response to these Statements of Guidance must be conducted in a coordinated way across observing systems, as far as practical, through systematic exchange of information, consultation, with the aim to develop synergy. Accordingly, the current CEOS-WMO Database on User Requirements and Observing Capabilities served as the basis for the RRR process should be redesigned taking into account WIGOS and WIS requirements.

Engaging Members and Regional Associations

42. Building WIGOS will require both commitment and leadership from Members and Regional Associations. A comprehensive communication strategy will help them to understand the challenges they face in implementing WIGOS at national and regional levels and increase awareness of the technical guidance and other mechanisms that will be developed to assist and support them.

Coordination with Partner Organizations

43. WIGOS will ensure a coordinated WMO contribution to the IOC-led GOOS and FAO-led GTOS and will be key to the successful implementation of GCOS in support of the UNFCCC, and in the development and implementation of GFCS. Through WIGOS and WIS, and their support for GOOS, GTOS and GCOS, WMO will make a fundamental contribution to the success of the Global Earth Observation System of Systems (GEOSS). The contribution of WMO to GEOSS provides a venue for greater exposure of the valuable work of WMO Members to a broader community. To further enhance partnership and collaboration within the frame of WIGOS, partner organizations will be encouraged to collaborate with:

- WMO in establishing appropriate coordination mechanisms,
- WMO to create and maintain interoperability among observing systems, and
- WMO on data policy.

44. WMO Space Programme will ensure coordination of the space-based component of WIGOS though interaction with CEOS and CGMS.

Strengthening Capacity Building

45. A coordinated capacity-building effort is an exceptionally important part of the WIGOS Implementation Strategy. It should assist developing and least developed countries to improve and sustain their contributions to WIGOS observing systems, including access to and effective utilization of

observations, data and products, and related technologies. As a key factor in successful WIGOS implementation, capacity building activities at national and regional levels will be focused on:

- Institutional mandates and policies;
- Infrastructure establishment and/or strengthening;
- Human skills development and training;
- Technical assistance; and
- Technology transfer.

46. To take advantage of WIGOS benefits and to ensure that information and services are used to the maximum extent possible, transfer of technological innovations and development of decision support tools will be essential. For this purpose, specialized education and training activities should be reflected in the Regional WIGOS Implementation Plans, especially for NMHSs of Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

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Appendix III

WIGOS TEST OF CONCEPT DEVELOPMENT AND IMPLEMENTATION PLAN (WDIP)

(A Concise version as requested by EC-LXII1[)])

Introduction

Cg-XV agreed that planning and implementation of the WIGOS test of concept should proceed in phases defined by the annual sessions of the WMO Executive Council in order to assure oversight, review and direction. To that end, Cg-XV requested EC-LIX to appoint a Working Group to oversee WIGOS and WIS. The process foreseen was one where planning and implementation of WIGOS would be considered at Cg-XVI (2011), and the WIGOS Implementation Plan for the next intersessional period would be determined.

The WIGOS Test of Concept Development and Implementation Plan (WDIP) took into account the WIS Development and Implementation Plan, and was be updated annually during the four-year period 2008-2011. Meetings of EC-WG/WIGOS-WIS provided oversight and guidance regarding the evolution of the Plan, which subsequently were considered at each session of EC. The Roadmap below is broken into annual Phases timed according to sessions of EC.

STATUS of the testing the WIGOS concept

Test of Concept, Phase I. Cg-XV (May 2007) – EC-LX (June 2008)

(1) Establish and update as appropriate the WIGOS Concept of Operations (CONOPS); (Status: Completed);

(2) Cg-XV through the EC-LIX establishes the EC-WG/WIGOS-WIS to oversee the development of WIGOS and WIS; (Status: Completed);

(3) Full time WIGOS Planning Unit organized in the WMO Secretariat (June 2007); (Status: Partially done); (Status as by Oct. 2010: the WIGOS Planning Office staffed by one officer);

(4) Coordinate with IOC regarding the WIGOS-WIS initiatives; (Status: Completed);

(5) Initiate the preparation of the draft WDIP v.1.0 (completion by Dec. 2007). Present the draft WDIP v.1.0 to EC-WG/WIGOS-WIS; (Status: Completed);

(6) Initiate first Pilot Projects:

- (a) Joint GOS-GAW Pilot Project to accelerate implementation of WIGOS-WIS; (Status: Initiated);
- (b) Initiation of Global Hydrological Network addressing a GCOS Requirement; (Status: (Status: Initiated));
- (c) Integration of AMDAR into WIGOS; (Status: Initiated);
- (d) Elaborating the underpinning/crosscutting role and responsibilities of the Instruments and Methods of Observation Programme; (Status: Initiated);
- (e) Integration of marine meteorological and other appropriate oceanic observations into the WMO Global Observing System; (Status: Initiated).

(7) Adjust draft WDIP and CONOPS v.1.0 as guided by EC-WG/WIGOS-WIS and present draft WDIP and draft CONOP v.1.1 to EC-LX; (Status: Completed);

(8) The agendas of technical commissions and regional associations should include an item relating to the Integration of WMO Observing Systems and should seek their “consensus inputs” to the WDIP to which the EC-WG/WIGOS-WIS would provide an input; (Status: done);

(9) At the Meeting of Presidents of Technical Commissions a major agenda item should be the WDIP to which the EC-WG/WIGOS-WIS would provide input. (Status: Partly completed);

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1 The full version of WDIP in English is available at http://www.wmo.int/pages/prog/www/wigos/index_en.html

(10) Initiate planning for the eight Demonstration Projects (see paragraph IX.); (Status: Done in the case of six);

Test of Concept, Phase II. EC-LX (June 2008) - EC-LXI (June 2009)

(1) EC-LX provides guidance for this phase; (Status: done);

(2) Review and update as appropriate the WIGOS CONOPS and WDIP; (Status: done);

(3) Initiate planning for the Pilot Projects concerning the integration of marine meteorological and oceanographic observations with WIGOS-WIS; (Status: done);

(4) The Pilot Projects (PP) begun in Phase I evaluated by corresponding Project Teams and SG-WIGOS; adjustments to the WDIP may arise from the evaluations; (Status: ongoing with a good progress: PP-I: Implementation Plan is missing; PP-II: change of the project; PP-III: Ongoing; PP-IV: Ongoing; PP-V: Ongoing);

(5) Coordinate with GTOS regarding terrestrial initiatives of relevance to WIGOS; (Status: pending, waiting for GCOS proposal on new PP);

(6) Additional Pilot Projects may be identified; (Status: done: EC-WG: reviewed and agreed with new proposals for GRUAN and GSICS Pilot Project);

(7) Demonstration Projects begun in Phase I evaluated by SG-WIGOS; adjustments to the WDIP may arise from the evaluations; (Status: Ongoing; project implementation plans to be submitted);

(8) Schedule possible concurrent sessions of CAS and CBS with joint agenda items regarding the integration of GAW and GOS into WIGOS; (Status: Coordination underway);

(9) Initiate work on the proposed revision to the WMO Technical Regulations; (Status: noted that some actions are required on Technical Regulations to be accomplished upon completion of Pilot and Demonstration Projects; initial discussion on the technical regulations is needed considering lessons learned);

(10) Revise WDIP and CONOPS and submit to EC–LXI for review and guidance; (Status: done);

(11) The agendas of technical commissions and regional associations should include an item relating to the Integration of WMO Observing Systems (including relevant components of co-sponsored observing systems) and should seek their “consensus inputs” to the WDIP to which the EC-WG/WIGOS-WIS would provide input; (Status: done at CHy-XIII, XIV-RA II, CBS TECO-WIGOS; XV-RA IV, CBS-XIV);

(12) Coordinate a way that RA working bodies can be involved into WIGOS activities in the Region (Status: started: initiated for two RAs (II, IV) that met during the period);

(13) Develop a reporting mechanism for Pilot and Demonstration projects; (Status: Ongoing);

(14) Elaborate basic definitions of WIGOS operations; (Status: Ongoing);

(15) Elaborate three areas of integration; (Status: done; significant revision achieved);

(16) Elaborate guidance on Demonstration Projects; (Status: Ongoing);

(17) Organize a workshop to facilitate the use of DCPCs in Pilot and Demonstration Projects; (Status: Pending).

Test of Concept, Phase III. EC-LXI (June 2009) - EC-LXII (June 2010)

(1) EC-LXI provides guidance for this phase (note this is the last period for active planning before specific proposals are prepared for submission to Cg-XVI); (Status: done)

(2) Review and update as appropriate WIGOS CONOPS and WDIP; (Status: done)

(3) Agreed activities of Pilot and Demonstration Projects begun in Phase I and II should be completed and evaluated for viability of the WIGOS concept. Experiences from Pilot and Demonstration Projects to be reflected in the draft Implementation Plan for WIGOS; (Status: Majority of Projects are still underway and will continue after Cg-XVI)

(4) SG-WIGOS meets in 2009 to consider status of Demonstration and Pilot Projects, updates of CONOPS and WDIP and formulate recommendations for EC-WG/WIGOS-WIS; (Status: done)

(5) EC-WG/WIGOS-WIS meets in 2010 to elaborate draft recommendations for EC-LXII; (Status: done)

(6) The agendas of technical commissions and regional associations should include an item relating to the WIGOS and should seek their "consensus inputs" to the WDIP; (Status: done)

(7) Finalize elaboration of areas of integration; (Status: done)

(8) Elaborate standardized description of all observing networks contributing to WIGOS; (Status: done)

(9) Develop WIS component (e.g. DCPC) for each Demonstration and Pilot Project when needed; (Status: pending)

(10) Develop Guidance for NMHSs why and how to optimize their observing network by integration of their observing systems; (Status: pending)

(11) Coordinate with GCW regarding cryospheric initiatives of relevance to WIGOS; (Status: ongoing)

(12) Further WIGOS implementation activities for the period May 2009 – March 2010 were considered by the second session of the Executive Council Working Group on the WMO Integrated Global Observing System and the WMO Information System (EC-WG/WIGOS-WIS-2), 6 - 8 May 2009, and were included in the Future Work Programme and Action Plan of EC WG (Reference: Final Report of EC-WG/WIGOS-WIS-2, Appendix IV).

Test of Concept, Phase IV. EC-LXII (June 2010) - Cg-XVI (May 2011)

(1) EC-LXII to agree on the content of the submission to Cg-XVI regarding the implementation of WIGOS. This will include the proposed changes to the Technical Regulations, the revised roles and Terms of References of the various technical commissions, the adjustments to the WMO Programme structure, and the impact on the Secretariat budgets and personnel, proposed actions of Cg-XVI how to implement WIGOS; (Status: done)

(2) Subgroup WIGOS meets in 2010 to formulate advice and recommendations to EC-WG WIGOS-WIS; (Status: done)

(3) EC-WG WIGOS-WIS considers matters relating to the revision of the Technical Regulations, the TORs of technical commissions, and proposals regarding WMO Programme structure and content, and the WMO Secretariat structure will be addressed in this Phase; (Status: done)

(4) Coordinate a way that RA working bodies can be involved into WIGOS activities in the Region; (Status: done)

(5) Pilot and Demonstration Projects will be evaluated for sustained legacy within WIGOS if appropriate. Experiences and lessons learned from Pilot and Demonstration Projects will be reflected in WDIS and in the skeleton of WIGOS Implementation Plan; several projects will continue during the implementation phase of WIGOS. (Status: done)

(6) Test of concept WDIP and CONOPS are completed; the WDIS is completed and the skeleton WIGOS Implementation Plan (WIP) is developed; (Status: done)

(7) EC-WG WIGOS-WIS submits its final report on the Integration and recommendations to Cg-XVI. (Status: done)

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Appendix IV

WORLD METEOROLOGICAL ORGANIZATION

WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

WIGOS CONCEPT OF OPERATIONS (CONOPS)

Version 5.2

APPROVAL PAGE

WIGOS CONOPS intends to contribute to the implementation activities under the following WMO STRATEGIC THRUSTS:

I. Improving Service Quality and Service Delivery

II. Advancing Scientific Research and Applications as well as Development and Implementation of Technology

III. Strengthening Capacity Building

IV. Building and Enhancing Partnerships and Cooperation

V. Strengthening Good Governance

and specifically, to the implementation of the Organization-wide Expected Result 4:

Enhanced capabilities of Members to access, develop, implement and use integrated and interoperable surface-based and space-based systems for weather, climate and hydrological observations, as well as related environmental observations, based on world standards set by WMO and partner organizations.

WIGOS CONOPS RELEASE APPROVAL (Date): 17 June 2010

BODY: WMO EXECUTIVE COUNCIL (EC-LXII, paragraph 3.4.67 of the general summary)

DOCUMENT VERSION CONTROL

Version	Author(s)	Date	Description
0.1	Ondras, Dombrowsky	Dec 2007	Draft for review by EC-WG/WIGOS-WIS-1
0.1			Feedback from EC-WG/WIGOS-WIS-1 (no changes)
1.0		June 2008	Draft for consideration by EC-LX
1.0			Feedback from EC-LX (no changes)
2.0	WIGOS-PO	Nov 2008	Draft for the review by EC-WG/WIGOS-WIS-1
2.1			Feedback from EC-WG/WIGOS-WIS-1 (deep review)
2.2	WIGOS-PO	May 2009	Draft for review by EC-WG/WIGOS-WIS-2
2.3	WIGOS-PO	May 2009	Feedback from EC-WG/WIGOS-WIS-2 (Part 5.4 elaborated)
3.0	WIGOS-PO	June 2009	Draft for consideration by EC-LXI
3.0			Feedback from EC-LXI (no changes)
4.0	WIGOS-PO	Oct 2009	Draft for the review by EC-WG/WIGOS-WIS-2 (significant change of the structure; addition of new text)
4.1.0	WIGOS-PO	Oct 2009	Feedback from EC-WG/WIGOS-WIS-2 (editorial changes)
4.1.1	WIGOS-PO	March 2010	Consistency with WDIS
4.1.2	CBS/CIMO	March 2010	Feedback from CBS-CIMO/WIGOS-CM
4.1.3	EC-WG	March 2010	Decision by EC-WG/WIGOS-WIS-3
4.1.4	WIGOS-PO	April 2010	Feedback from EC-WG/WIGOS-WIS
5.0	EC-LXII	June 2010	Approval of version 4.1.4
5.1	WIGOS-PO	Oct 2010	Feedback from the Secretariat and SG-WIGOS-3
5.2	WIGOS-PO	Feb 2011	Decision by EC-WG/WIGOS-WIS-4

CONTENTS

1 SCOPE OF DOCUMENT

1.1 Identification of CONOPS

In accordance with international standards, the Concept of Operations (CONOPS) is a user-oriented document that describes characteristics of the to-be-delivered system from an integrated viewpoint. The CONOPS document also describes user requirements for and expectations from the proposed system and how the system should operate to fulfil those needs.

The ideas expressed in this WMO Integrated Global Observing System (WIGOS) Concept of Operations document are the results of analyzing the challenges involved in the implementation of the WMO integration strategy endorsed by the Fifteenth World Meteorological Congress (Cg-XV) in 2007.

To guide the transition of WIGOS during the Test of Concept Phase (2007-2011), the WIGOS Development and Implementation Plan (WDIP) was adopted by the Executive Council in 2008 (EC-LX). In accordance with a decision of EC-LXI, the WIGOS Development and Implementation Strategy (WDIS) was developed, for which CONOPS is a main reference.

1.2 CONOPS document purpose

The purpose of this document is to describe the WIGOS concept of operation. It serves as a basic means to communicate the high-level quantitative and qualitative characteristics of WIGOS to the user community within and outside of WMO and other stakeholders at the national and international levels.

Users might read the CONOPS document to determine whether their needs and expectations have been correctly identified, while the developers will typically use this document as a basis for WIGOS development and implementation activities described in WDIP and in the WIGOS Implementation Plan (WIP) that will developed after approval by Cg-XVI in 2011.

1.3 WIGOS overview

1.3.1 Background

Various observing systems throughout WMO Programmes and WMO partner organizations have been developed, funded, managed and operated to meet their own specific purposes. By adopting the WIGOS strategy, Cg-XV wished to establish a comprehensive, coordinated and sustainable system of observing systems in order to satisfy evolving observing requirements of WMO and WMO co-sponsored Programmes in a cost-effective manner.

1.3.2 Vision

The WIGOS Vision calls for an integrated, coordinated and comprehensive observing system to satisfy, in a cost-effective and sustained manner, the evolving observing requirements of WMO Members in delivering their weather, climate, water and related environmental services. WIGOS will enhance the coordination of WMO observing systems with those of partner organizations[2)] for the benefit of society.

WIGOS will provide a framework for enabling the integration and optimized evolution of WMO observing systems, and of WMO's contribution to co-sponsored systems. Together with the WMO Information System (WIS), this will allow continuous and reliable access to an expanded set of environmental data and products, and associated metadata, resulting in increased knowledge and enhanced services across all WMO activities.

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2) In this document "partner organizations" means intergovernmental, non-governmental and international organizations and groupings that operate, or co-sponsor, with WMO, observing systems that contribute to WIGOS. The main partner organizations are UNESCO and its IOC, UNEP, FAO and ICSU and the main cosponsored observing systems are GCOS, GOOS and GTOS; partner organizations also include GEO.

1.3.3 Purpose

The purpose of WIGOS is to provide the effective and sustainable organizational, programmatic, governance and procedural structures that will significantly improve the availability, usefulness**,** quality and utilization of observational data and products through a single focus for the operational and management functions of all WMO observing systems as well as a mechanism for interactions with WMO co-sponsored observing systems.

WIGOS will allow WMO Members' NMHSs and other relevant national and international institutions to better fulfil their mandates, including response to natural hazards, hydrological and environmental monitoring, climate observation, and adaptation to climate change and human-induced environmental impacts.

1.3.4 Integration

Following the guidelines by Cg-XV, integration in the context of WIGOS should be defined as joint efforts by data users and data producers at the national and international levels to establish a comprehensive, coordinated and sustainable system of observing systems, ensuring interoperability between its component systems. It will be a framework facilitating standardization and interoperability and ensuring availability and utilization of, and access to, good-quality data and products, and associated metadata.

1.3.5 General characteristics

Resolution 30 (Cg-XV) recognized WIGOS as a major effort of the Organization. Its development should proceed concurrently with the planning and implementation of WIS. The combination of both efforts will allow for an integrated WMO end-to-end system of systems designed to improve Members' capabilities to effectively provide a wide range of high quality services and to better serve all WMO Programmes requirements.

WIGOS will build on and add value to the WMO's existing observing systems by coordinating their efforts, addressing shortcomings, and supporting their interoperability, while satisfying the observing requirements of WMO and WMO co-sponsored Programmes in a cost-effective manner.

WIGOS will provide a mechanism for interaction and cooperation with the WMO co-sponsored observing systems, respecting partnership, ownership and data-sharing policies of all observing components and partner organizations. WMO will work with partner organizations to achieve maximum commonality of standards and practices across the co-sponsored observing systems.

Cg-XV stressed that this endeavour would have an impact on the structure and functions of WMO, the WMO Programme structure, roles, terms of reference and working arrangements of technical commissions, the WMO Technical Regulations, and the WMO Secretariat.

1.3.6 Benefits

In order to meet the evolving requirements of WMO Members, there is a well-recognized need to improve existing observing capabilities, make them more cost-effective, sustain their operation and enhance service delivery. Integration of respective components and systems must be pursued to ensure interoperability, and optimize observing components within WIGOS. WIGOS will also enable resources to be used more efficiently and effectively to overcome existing deficiencies and gaps.

WIGOS is expected to provide timely, quality-assured, quality-controlled and well-documented long-term observations. Implementing Quality Management procedures will be required to enable enhanced utilization of both existing and emerging observing capabilities. In order to meet the evolving user requirements, WIGOS, together with WIS, will:

- Enable the evolution and integration of WMO observing systems and enhance collaboration with its partner organizations: this will allow access to an expanded set of environmental data and products resulting in increased knowledge and enhanced services (across weather,

water and climate domains) in a cost-effective manner;

- Result in enhanced observing capabilities by improving interoperability and coordination between their surface- and space-based components;
- Enable WMO Members to meet expanding national mandates which are calling for increasing coordination and integration with other national agencies to help them better respond to natural hazards, improve weather, water, climate and related environmental monitoring, and adapt to climate change and other human-induced environmental impacts;
- Enhance operational components of WMO Programmes, especially in Developing and Least Developed Countries and ensure essential WMO support for the observational and information elements of the Global Framework for Climate Services (GFCS);
- Enhance coordination with, and contribute strongly to GOOS, GTOS, and GCOS, and to the Global Earth Observation System of Systems (GEOSS); and
- Provide a basis for sound decision making and enhance delivery of services to society.

An integrated global observing system, supported by an interoperable information system, will be essential for realizing the socio-economic benefits from the wide range of weather, climate, water and related environmental products and services, based on WMO's core competencies in environmental monitoring.

WIGOS will be an essential component of WMO's strategic activities. It will ensure a coordinated WMO contribution to the cosponsored GOOS and GTOS and will be key to the successful implementation of GCOS in support of the UNFCCC, and in the development and implementation of the GFCS. Through WIGOS and WIS, and their support for GOOS, GTOS and GCOS, WMO will make a fundamental contribution to the success of the Global Earth Observation System of Systems (GEOSS).

2 REFERENCED DOCUMENTS

The following documentation was used to support the generation of this document.

2.1 Reports of WMO Constituent bodies

- Fifteenth World Meteorological Congress, Abridged Final Report with Resolutions (WMO-No. 1026);
- EC-LVIII, Abridged Final Report with Resolutions (WMO-No. 1007);
- EC-LIX, Abridged Final Report with Resolutions (WMO-No. 1027);
- EC-LX, Abridged Final Report with Resolutions (WMO-No. 1032);
- EC-LXI, Abridged Final Report with Resolutions (WMO-No. 1042);
- CBS-XIV, Abridged Final Report with Resolutions and Recommendations (WMO-No. 1040);
- Final report of the 1st session of the EC WG on WIGOS-WIS (December, 2007);
- Final report of the 2nd session of the EC WG on WIGOS-WIS (May, 2009);
- Final report of the 1st session of the Subgroup on WIGOS of the EC WG on WIGOS-WIS (November, 2008);
- Final report of the 2nd session of the Subgroup on WIGOS of the EC WG on WIGOS-WIS (October, 2009).

2.2 WMO regulatory material and International Standards

- Basic Documents, No. 1, 2007 edition (WMO-No. 15);
- Technical Regulations (WMO-No. 49);
- Manual on the Global Observing System (WMO-No. 544);
- Manual on the Global Telecommunication System (WMO-No. 386);
- Manual on Codes (WMO-No. 306);

- Manual on the Global Data-processing and Forecasting System (WMO-No. 485);
- Weather Reporting, Volume A (WMO-No. 9);
- Guide to the Global Observing System (WMO-No. 488);
- Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8);
- Global Atmosphere Watch Measurements Guide (WMO-No. 143);
- Guide to Marine Meteorological Services (WMO-No. 471);
- Guide to Agricultural Meteorological Practices (WMO-No. 134);
- Guide to Climatological Practices (WMO-No. 100);
- Guidelines on the Role, Operation and Management of National Hydrological Services (WMO-No. 1003);
- WHYCOS Guidelines (WMO/TD-No. 1282);
- ISO 14001 Environmental Management Systems;
- ISO 9001 2008 Quality Management Requirements.

2.3 Other relevant documentation

- WIGOS Development and Implementation Plan (WDIP) (EC-LXII, 2010);
- WIGOS Development and Implementation Strategy (WDIS) (EC-LXII, 2010);
- Vision for the GOS in 2025 (CBS-XIV, 2009);
- WIS Project and Implementation Plan (v. 1.2, February, 2010);
- Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (GCOS-92, WMO/TD-No. 1219);
- Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (2010 Update GCOS-138; WMO-TD/No. 1523);
- GCOS Reference Upper-Air Network (GRUAN): Justification, requirements, siting and instrumentation options (GCOS-112, WMO/TD-No. 1379);
- WMO Global Atmosphere Watch (GAW) Strategic Plan: 2008-2015 (WMO/TD-No. 1384);
- Implementation Plan for Evolution of Space-and Surface-based Subsystems of the Global Observing system (WMO/TD-No. 1267);
- CBS TECO-WIGOS Conference Statement (March, 2009);
- WIGOS as a Challenging Initiative of WMO, Keynote by T. Sutherland, Second Vice-President of WMO (CBS TECO-WIGOS, March 2009);
- The first U.S. Integrated Ocean Observing System (IOOS) Development Plan, Washington, DC, January 2006;
- Global Earth Observation System of Systems GEOSS 10-Year Implementation Plan (GEO 1000, February 2005);
- GEO 2009-2011 Work Plan (January 2009);
- IEEE Guide for information Technology- System Definition –Concept of Operations (CONOPS) Document, 1988;
- NOAA Concept of Operations (CONOPS) for NPOESS Data Exploitation (NDE), 2006;
- Concept of Operations (CONOPS) for the National Archives and Records Administration Electronic Records Archives Program Management Office (NARA ERA PMO), 2004;
- EUCOS programme management documentation;
- THORPEX International Research Implementation Plan (WMO/TD-No.1258);
- Proceedings of the Third WMO Workshop on the Impact of Various Observing Systems on NWP, Alpbach, Austria, 9-12 March 2004;
- Proceedings of the Fourth WMO Workshop on the Impact of Various Observing Systems on NWP, Geneva, Switzerland, 19-21 May 2008;
- JCOMM Observing System Implementation Goals for Building a Sustained Global Ocean

Observing System in Support of the Global Earth Observation System of Systems (2009);

- CIMO Management Group, Seventh Session, Geneva, Switzerland, 15-19 February 2010;
- CBS Management Group, Eleventh Session, Geneva, Switzerland, 17-19 March 2010.

3 CURRENT WMO AND CO-SPONSORED OBSERVING SYSTEMS

3.1 Description of Existing Systems

Currently, WMO and co-sponsored observing systems are organized as multiple systems comprising:

(a) Surface-based component of the Global Observing System (GOS) of the World Weather Watch (WWW) Programme;

(b) Space-based component of the GOS, including the geostationary meteorological satellite constellation, the core polar-orbiting meteorological constellation and R&D earth observation satellites;

(c) Aircraft Meteorological Data Relay (AMDAR) systems including expansions of aircraft measurement capabilities for atmospheric composition constituents;

(d) Marine meteorological and relevant oceanographic observing networks of the Global Ocean Observing System (GOOS);

(e) Relevant components of atmospheric, oceanographic and terrestrial observing systems contributing to the Global Climate Observing System (GCOS);

(f) Relevant terrestrial networks of the Global Terrestrial Observing System (GTOS);

(g) Regional, river basin and global hydrological networks such as the World Hydrological Cycle Observing System (WHYCOS);

(h) Global Atmosphere Watch (GAW) networks and systems for observation of atmospheric chemical composition and related environmental parameters;

(i) Various radiation networks;

(j) The observing component of the proposed Global Cryosphere Watch (GCW) approved by Cg-XV.

3.2 Operational Policies

Current WMO and co-sponsored observing systems are generally designed to meet the need for monitoring the state and composition of the atmosphere, land and ocean on global, regional and national scales. The resulting data and information, as well as the forecasts and warnings generated are internationally exchanged. Such information is required to improve understanding of the behaviour of the atmosphere and its interaction with land, oceans and biosphere to enable prediction of the future states of the Earth system.

With respect to the implementation of the above WMO and co-sponsored observing systems, the guiding principle is that all activities and facilities connected with the establishment and operation of observing network(s) on the territories of individual countries are the responsibility of the countries themselves and should be met to the extent possible from national resources. Where this is not possible, assistance may be provided through multilateral (regional) or bilateral cooperation programmes.

Implementation of certain observing systems outside the territories of individual countries (e.g. outer space, the oceans and the Antarctic) is based on the principle of voluntary participation of countries that desire and are able to contribute by providing facilities and services either individually or jointly from their national resources or through collective financing.

3.3 Classes of Users and Application areas

NMHSs continue to be the principal owners/operators[3)] and major users of data and information generated by the existing observing systems mentioned above. However, the user community is also represented by a growing diversity of stakeholders and decision makers, including national agencies, academia, non-governmental organizations, public and private sectors and other societal areas. Depending on the observational data requirements and services provided, the end-user is affiliated to and represents the following: (a) socioeconomic sectors; and (b) activities of NMHSs:

(a) Agriculture and food production; aviation; land transport; maritime transport; marine resources; water resources; industry; disaster mitigation and prevention, emergency response; and energy;

(b) Weather analysis and forecast, including early warning; marine weather and oceanographic services; hydrology; environmental monitoring; public weather services, health and safety; climatology and climate services.

Furthermore, the Statement of Guidance (SOG) for each of the application areas below has been developed and updated by the CBS OPAG IOS through the Rolling Review of Requirements (RRR) process (see Section 5.2.5):

- Global Numerical Weather Prediction;
- Regional Numerical Weather Prediction;
- Synoptic meteorology;
- Nowcasting and Very Short-range Forecasting;
- Seasonal and Inter-annual Forecasts;
- Atmospheric chemistry;
- Aeronautical meteorology;
- Ocean applications;
- Climate monitoring;
- Climate applications;
- Hydrology;
- Agricultural meteorology.

It is expected that above application areas will be expanded to cover evolving WIGOS user requirements such as GCW, Space Weather.

4 JUSTIFICATION FOR INTRODUCTION OF WIGOS AND DESCRIPTION OF CHANGES NEEDED

4.1 Justification of changes

An increasingly complex society and sophisticated user community, reflected by rapid economic and industrial development, coupled with increased knowledge of the planet as an integrated system and the changing Earth's climate has resulted in greater vulnerability of nations to extreme weather events and climate change. This has resulted in the need for timely, more extensive and advanced information for WMO Members so that they can continue to improve service quality and service

3) This is more likely the case for surface-based systems; only a smaller number of NMHSs own/operate space-based observing systems directly.

delivery. To meet the demands of the future, WMO Members need to continue their legacy of contributions by taking full advantage of advances in observation and telecommunication technologies and to increase the scientific understanding of the Earth and its environment: the end result being better prediction and assessment of potential impacts of weather- and climate-related events to provide the required information for the public and policy and decision makers.

Historically however, various WMO and WMO co-sponsored Programmes, involving observing systems, have not been developed in a coordinated, integrated manner but have been managed, funded and operated separately to meet their own purposes and goals. Under these arrangements it was not possible to standardize different observing practices including dissemination and processing of data, which is now crucial to effectively respond to rapidly evolving user requirements mentioned above. Also, WMO regulatory material was not harmonized accordingly to assure clear and transparent guidance for Members. These factors seriously hampered the evolution of WMO observing systems in a cost-effective manner. Coordination of observing programmes with partner organizations was also not sufficient.

In the view of the above, a proposed integration of existing observing systems is a necessary prerequisite to allow WMO Members to realize the strategic thrusts of WMO which are:

- Improving service quality and service delivery;
- Advancing scientific research and application as well as development and implementation of technology;
- Strengthening capacity building;
- Building and enhancing partnerships and cooperation;
- Strengthening good governance.

WIGOS, as determined by Cg-XV, is a major contribution of WMO to the challenges outlined above. Cg-XV decided that the enhanced integration of WMO observing systems should be pursued as a strategic objective of WMO and identified this as a major expected result of the WMO Strategic Plan.

4.2 Description of expectations and desired changes

WMO and co-sponsored observing programmes aim to improve and sustain environmental observations (see Section 3). However, along with the progress in accomplishing tasks related to the WMO strategic thrusts listed in Section 4.1, current efforts in some regions are still limited, for example, by the following:

- Uncertainty about continuity of observations;
- Large spatial and temporal gaps in specific data sets;
- Lack of relevant processing systems to transform data into useful information;
- Insufficient long term data archiving;
- Eroding technical and organizational infrastructure;
- Inadequate user involvement;
- Lack of access to data and associated benefits, especially in least developed countries;
- Inadequate data integration and interoperability;
- Insufficient coordination and data sharing among Members, organizations and programmes.

Therefore, to bring the current observing systems in line with the evolving requirements, the desired changes should encompass activities to address at least the above factors with a goal to minimize their effects. In this way WIGOS will provide the opportunity to better utilize existing and emerging observing capabilities, thus facilitating accomplishment of required changes. In particular, it is expected that WIGOS will:

- Develop strategies to guarantee systems interoperability, including meeting documented standards for data quality of observing systems and instruments;

- Evaluate existing and emerging capabilities before developing, acquiring, and/or deploying new observing systems or sensors, and in the design of cost-effective composite observing systems;
- Develop strategies to satisfy observing requirements of WMO Programmes and international partners through the WMO RRR Process;
- Develop a strategy for the production, editing and management of metadata, including instrumentation/platform and data discovery;
- Promote exploitation of existing platforms and employment of the multi-sensor platform concept to the maximum possible extent; and
- Coordinate the response to requirements, plans and activities with all WMO technical commissions, regional associations and Programmes.

Within the WIGOS, observational data, metadata and processed observational products from WMO and, to the extent possible, co-sponsored observing systems will:

- Adhere ultimately to WIGOS standards for instruments and methods of observation as well as standard observing network practices and procedures;
- Be exchanged via WIS using agreed upon data and metadata representation forms and formats;
- Use hardware and software that are compatible with WIGOS requirements;
- Be archived in compliance with WIGOS/WIS requirements.

4.3 Priorities among changes

Classifying the changes and new features into *essential and desirable* categories is important to guide the decision making process during the development and implementation of WIGOS.

4.3.1 Essential changes

Features that ***should*** be provided by the new or modified observing system(s) are as follows:

- Enhanced capabilities to meet all WMO Programmes' requirements in the most cost-effective approach, reducing the financial burden on Members while maximizing administrative and operational efficiency and effectiveness;
- Ensured observing systems interoperability, data compatibility and traceability of observations from all WIGOS observing components;
- Quality Management System (QMS) implemented according to WMO Programme requirements by data producers/owners of observing systems/networks;
- Improved access in real-time, near-real-time and delayed mode to wider range of observations required to meet the needs of Members through WMO and WMO co-sponsored programmes, as well as relevant international conventions;
- Improved metadata, data management, archival and data retrieval capabilities;
- More efficient delivery of observational data and products to users;
- Strengthened capabilities of all Member countries to access and utilize observations from all WMO and co-sponsored observing systems.

4.3.2 Desirable changes

Features that ***could*** be provided by the new or modified system(s) are as follows:

- The optimum integration of the various components of all observing programmes;
- Capabilities to effectively adjust and respond to changing requirements;
- Facilitated technological innovation opportunities;

- Improved collaboration with instrument manufacturers and scientific/research institutes in the development and testing of next generation observation instruments;
- Improved production, use and application of data and information from across all WMO and co-sponsored observing systems, in a seamless way, to satisfy user requirements;
- More rapid and effective assimilation of technological advances and their application across all observing programmes;
- Sharing observing platforms as far as practical to reduce redundancies.

4.4 Consolidation and cost benefits

WIGOS will support the establishment of an evolving optimized observing network(s) within a region(s) which results in a shared work load for the participating NMHSs along with enhanced capabilities and a fair cost allocation. WIGOS, inter alia, will use experiences gained by regional observing programmes such as the EUMETNET Composite Observing System (EUCOS) Programme, which has helped to eliminate duplications of effort in the upper air and surface observing components operated by NMHSs and ensured that the quality of all data delivered by the EUCOS networks has been maintained at a high level. In doing so, WIGOS will significantly enhance those capabilities of Members which they may not have been able to deliver on a national basis.

To move WIGOS forward in a cost-effective manner and to overcome differences in levels of development of national and regional systems and services, it will be required to develop Regional WIGOS Implementation Strategies that will guide, among other things, how Members within Regions can most effectively work together. Also, it is expected to develop regional cooperation programmes like EUCOS, which has already demonstrated very promising results for the testing of new observing strategies and indicated ways towards optimization. For the benefit of WIGOS, it will be also of great importance to exploit the lessons learned from the Data Buoy Cooperation Panel, where WMO and IOC as co-sponsors work together to coordinate a more robust and cost-effective observing system.

4.5 Technology improvements

Technological advances will be a crucial factor leading to improvement in sensors and system capabilities to accurately measure environmental variables. These advances will also allow their ability to withstand severe climate and environmental conditions. Progress in technology will continue to provide a basis for further improvements in the reliability and quality of observations, thus more fully satisfying user needs. Based on the above, within WIGOS, the following areas need to be addressed: Standardization, Automation, Testing, and Network design.

Standardization will address best procedures and practices, including quality assurance, data and metadata formats for new and emerging technologies. Standardization is necessary for all data and associated metadata so that the measurements from individual systems can be integrated into accurate and coherent data sets that allow for the development of unbiased, homogeneous long-term time-series.

Automation will enable growth at reduced costs by allowing for increases in data frequency and consistency while avoiding concurrent increases in labour costs. Further development of integrated surface-based remote sensing systems will make it possible to provide observations of key atmospheric variables and processes relevant to weather, water and climate with high time resolution.

Long-term ***testing*** at instrument “test-beds” will be used to judge instrument design, performance, reliability, capability, and cost-effectiveness for a full integration into WIGOS.

Network Design will be addressed through a coordinated effort of NMHSs and other data providers to minimize duplication and by optimization of the observing network design and its flexibility to incorporate new observing systems after their successful testing and evaluation.

5 WIGOS CONCEPT

5.1 Objectives and scope

Nowadays, rapid assessments of the current state of the Earth system and timely detection and prediction of changes in it are required by WMO stakeholders and its partners. Therefore, the establishment of an integrated operational observing system that routinely, reliably and continuously provides the information required, is essential.

Objectives

Cg-XV envisaged that WIGOS should encompass four broad objectives:

(a) Improving management and governance (use of resources, planning, institutional and programme structures, and monitoring);

(b) Increasing interoperability between the various systems with particular attention given to the complementarity between the space-based and *in-situ* components of the systems;

(c) Addressing the domains (atmospheric, oceanic and terrestrial, including hydrological) as a comprehensive total system;

(d) Ensuring that broader governance frameworks (e.g. inter-agency co-sponsorship of systems) and relationships with other international initiatives (e.g. GEO) are respected, sustained and strengthened.

Scope

In meeting the above objectives, WIGOS will serve WMO Members and partner organizations and will also make a major and unique contribution to United Nations agencies that are focused on environmental stewardship, and along with WIS, will be a core contribution of WMO to GEOSS.

To achieve these objectives, which were demonstrated in the Test of Concept Phase, the scope of WIGOS will encompass the following:

- *Requirements:* Provide a mechanism to meet evolving observing requirements of WMO Members and WMO partner organizations based on the RRR process;
- *Integration:* Build upon and add value to the existing WMO observing components of GOS, GAW, and WHYCOS with emphasis on integration of surface- and space-based observations;
- *Standardization:* Enhance observational data quality and homogeneity by introducing improved data quality and data management standards to better satisfy user requirements;
- *Access:* Improve access to, and utilization of, observations and products from WMO observing systems as well as those of co-sponsored systems;
- *Coordination:* Foster research and development activities and coherent planning for future observing systems and network optimization by working with all WMO Programmes and partner organizations.

5.2 Key elements of the operational WIGOS

Following the guidance by Cg-XV, WIGOS will build on and add value to WMO's existing observing systems by coordinating their efforts, addressing shortcomings, supporting their interoperability, while meeting user requirements.

The list of current observing networks as the key elements of the future operational WIGOS is given in Section 3. Integration, as a prerequisite to WIGOS implementation is described in Section 1.3.4. Cg-XV also identified that the progress with the WMO Information System (WIS) will be essential element for WIGOS. The WIGOS standardization process and quality management procedures will ensure that user requirements for various application areas are met at national, regional and global levels.

5.2.1 Integration, Standardization and Interoperability

It is envisioned that the integration process will bring about architectural and governance structures as well as processes for WIGOS development, implementation and sustainability. Standardization and interoperability, including data compatibility, are primary factors enabling integration.

Key areas of standardization

A key requirement for success is the standardization in three areas as shown schematically in Figure 1:

- Instruments and methods of observation;
- WIS information exchange and discovery;
- Quality management framework.

5.2.2 Standardization of instruments and methods of observation

WIGOS should strive for homogeneity, interoperability, compatibility and traceability of observations from all WIGOS observing components. This should be based on guidance and studies by the Instruments and Methods of Observation Programme (IMOP) and related programmes of partner organizations, including tests, calibration and intercomparisons.

5.2.3 WIS Information exchange and discovery

In order to effectively and efficiently respond to user data needs, WIGOS will use WIS as a data exchange, discovery, access, and retrieval mechanism. Observational data and products generated by all WIGOS constituent observing components, as well as associated metadata, shall meet a comprehensive, standardized set of WIS data and metadata exchange requirements.

Technologically, the key action leading to the desired integrated networks will be the generation of data and information from WIGOS observing components using comprehensive, standardized data representation. More specifically, the role of WIS will be as follows:

- It will be used in the collection and sharing of information for all WMO and related international programmes;
- It will provide a flexible and extensible structure that will allow participating centres to enhance their capabilities as their national and international responsibilities grow;
- It will provide communication facilities used for distribution of high priority real-time data;
- It will utilize international agreed-upon standards for protocols, hardware and software.

Detailed description of WIS is presented in the WIS Project and Implementation Plan (Section 2.3).

5.2.4 Quality Management Framework

The third key area of standardization for WIGOS should embrace a quality management framework (QMF) and the development, use and maintenance of the relevant WMO technical regulations to ensure that:

- Observations, records and reports on weather, water, climate and the natural environment are of documented quality for international exchange through the WMO coordinated systems and relevant joint standards with other international organizations;
- The best possible products and services are delivered to end users based on agreed-upon quality assurance and quality control standards.

The corresponding activities shall be compliant with Resolution 31 (Cg-XV), Implementation of Quality Management Systems by National Meteorological and Hydrological Services and Resolution 32 (Cg-XV), WMO Quality Management Framework.

WIGOS activities will assist Members in the implementation of quality management principles in their observing systems.

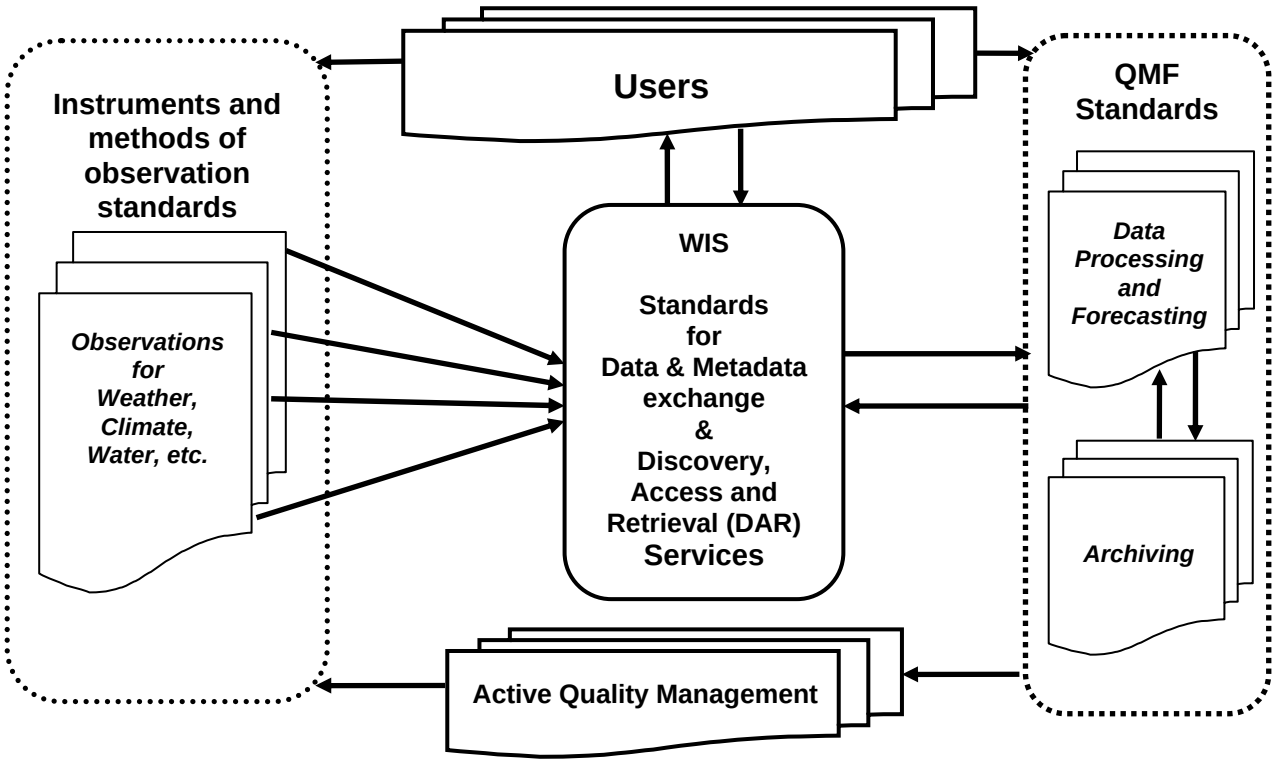

Figure 1: Key areas of WIGOS standardization

5.2.5 Rolling Review of Requirements (RRR) process and evolution of observing systems

To ensure continuous review of the requirements placed on the current observing systems and to have the capability to effectively adjust and respond to evolving needs, WIGOS will be using the same RRR process as currently specified for the Global Observing System (GOS) by the Manual on the Global Observing System (WMO-No. 544) (Part II, Requirements for observational data). In the RRR process, as schematically shown in Figure 2, user requirements for observations are compared with the capabilities of present and planned surface- and space-based observing systems to objectively indicate the feasibility of achieving the stated requirements for a given Application area (see Section 3.3). This step of the RRR process is called a Critical Review. The output of the Critical Review is reviewed by experts in the relevant application area and used to prepare Statements of Guidance (SOG), the main aim of which is to draw attention to the most important gaps between user requirements and observing system capabilities, and to suggest areas of progress towards improved observing systems in the context of the application. Eleven applications within WMO Programmes have already been addressed. Within WIGOS, the most significant variables for each Application area will continue to be analyzed in the SOGs. Both user requirements and observing system capabilities are collated in a comprehensive, systematic and quantitative way in the WMO/CEOS database, which is accessible at: http://www.wmo.int/pages/prog/sat/Databases.html.

As directed by Cg-XV, it is essential to implement the RRR Process to ensure that WIGOS will address and meet evolving stakeholders' requirements. Therefore, it is also essential that user requirements are kept continuously under review.

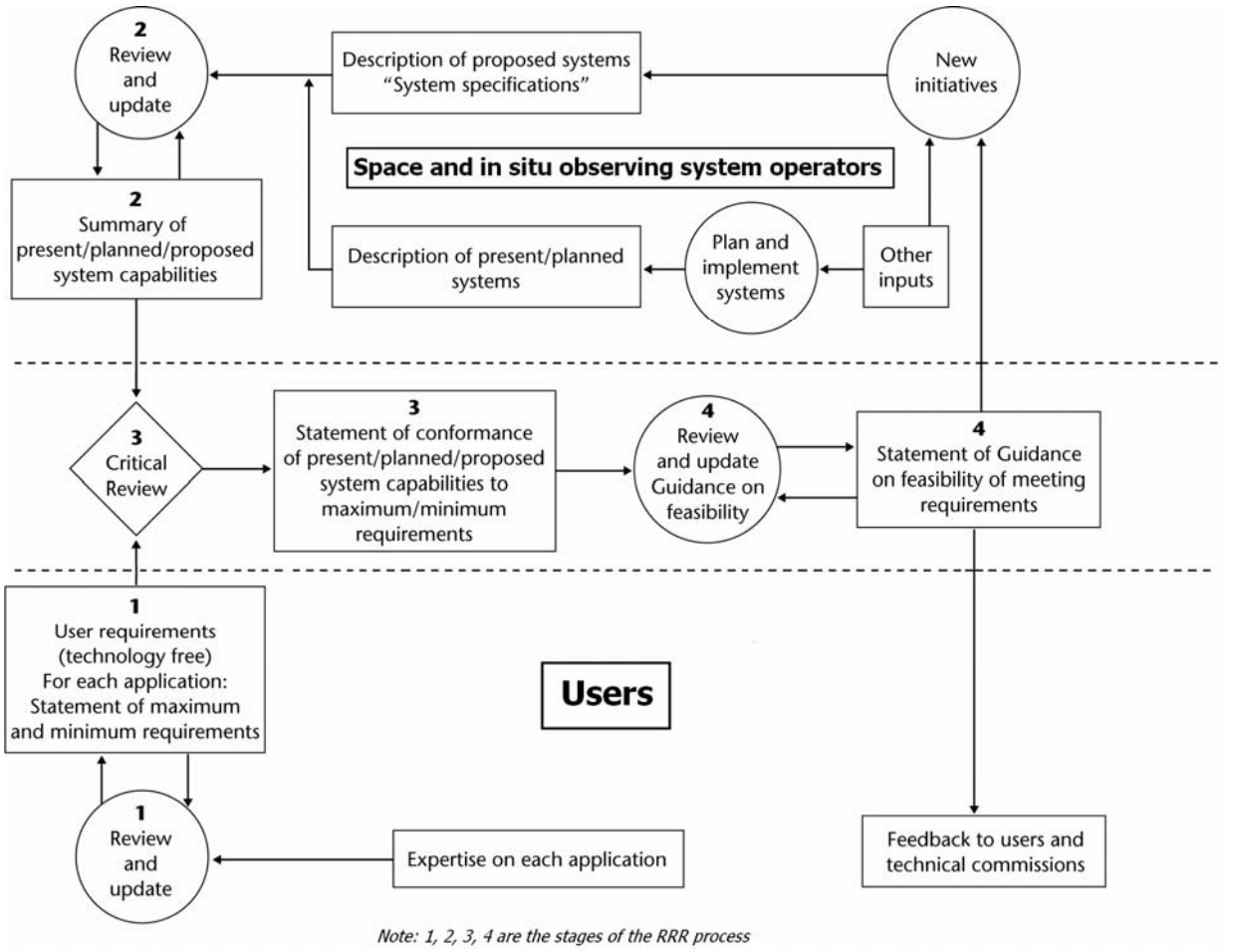

Figure 2: Rolling Review of Requirements Process

5.2.6 Operational Database

A distributed database (DB) describing all the observing systems components and respective networks contributing to WIGOS should be developed to provide end users with relevant metadata, crucial for the operation of WIGOS and for the WIS Data Discovery, Access and Retrieval (DAR) services. A database should allow users to make relevant recommendations in terms of network design, evaluation and optimization; system governance and management and all other aspects dealing with observing system operation and performance.

For the purposes of developing such a database, data producers will be fully responsible for providing adequate and sufficiently detailed metadata related to all parts of their observing systems and networks. Generally, the WIGOS operational database should include the following:

- Basic observing network/system characteristics (governance, management, observing programme, standard compliance information, data policy, etc.);
- Basic station characteristics (name, number/identifier, geographical coordinates, observing programme, etc.);
- Basic instrument characteristics (siting, exposure, sensor type, principle of operation, instrument performance); data-processing, handling, transmission, quality assurance information, etc.).

5.2.7 Standardization Database

A database of standards should be developed. It would provide a single access point to all WMO standards, guidelines, best practices, procedures, etc., addressing all aspects of observations (instruments, methods of observation, metadata format, coding, etc.).

Such a database would enable, on one hand, the network managers and operators to easily access the information they need to set-up and run their systems and, on the other hand, to help the data users to understand the standards that were used in performing specific observations they are considering to use, providing that appropriate metadata are available.

5.2.8 Roles and Responsibilities

Coordination of WIGOS observing components will require long-term commitments from all participants and mutual understanding by all partners to accomplish their current and planned observational activities in a coordinated manner. In order to move towards full WIGOS operations, the entities listed below are considered to have essential roles and should assume, along with their general terms of reference, the following responsibilities:

WMO Members:

- Evolve their observing systems to become their national component of WIGOS,
- Coordinate their WIGOS and WIS implementation activities,
- Provide experts to participate in the WIGOS related work of technical commissions,
- Provide adequate resources to the WMO Secretariat to support WIGOS implementation,
- Support regional and global WIGOS implementation activities,
- Keep the Secretary General informed about their WIGOS implementation activities.

Executive Council:

- Monitor, guide and support the implementation of WIGOS.

Regional Associations:

- Develop their regional WIGOS implementation plan,
- Coordinate WIGOS implementation activities with WIS in their operating plan and work programme,
- Promote capacity-building and outreach activities to assist Members in the implementation of WIGOS.

Technical Commissions:

- Guide the technical aspects of WIGOS implementation,
- Incorporate WIGOS implementation activities in their operating plan and work programme,
- Provide technical guidance and advice to Members and the Regional Associations on WIGOS,
- Develop guidance for the design and evolution of observing components of WIGOS,
- Develop standards to support WIGOS in collaboration with partner organizations and programmes, including those for metadata,
- Update WMO Regulatory Material, including development of the Manual on WIGOS,
- Provide the technical lead for WIGOS through the Commission for Basic Systems (CBS) and the Commission for Instruments and Methods of Observation (CIMO).

WMO Secretariat:

- Ensure management of, and provide adequate resources in support of the WIGOS implementation process;
- Establish a WIGOS Project Office;
- Develop proposals for programmatic and governance structures in support of WIGOS, taking into account WMO’s strategic directions;
- Ensure proper coordination with other observing systems contributing to the GFCS as it develops;

- Coordinate and collaborate WIGOS activities with UN organizations and other relevant organizations and programmes;
- Support regional associations and technical commissions in developing their WIGOS implementation strategies and projects, including outreach and capacity-building activities;
- Support the review and update of WMO Regulatory Material, including the development of the Manual on WIGOS,
- Work with Members and donors to provide adequate resources for WIGOS implementation.

Partner Organizations:

- Collaborate with WMO in establishing appropriate coordination mechanisms;
- Coordinate with WMO to create and maintain interoperability among observing systems;
- Coordinate with WMO on data policy.

5.2.9 Governance

WIGOS will establish standards for data integration and interoperability across all WMO observing systems. It will also provide a single focus for integrated and coordinated operational management of all WMO observing systems and a mechanism for coordination with WMO co-sponsored and contributing observing systems.

Therefore, in implementing WIGOS it is imperative that the current management, governance and support activities be reviewed and aligned with WMO strategic planning and results-based management. This alignment should enable collaboration and promote cooperation and coordination at the technical, operational and administrative levels.

Central coordination through the WMO Secretariat is essential for successful WIGOS implementation. In addition, the long-term commitment and effort of WMO Members; greater international cooperation; and sustained technological, capacity building, and financial support for developing and least developed countries is important.

The development of an effective and efficient system of governance will require adequate scientific and technical advisory mechanisms to develop, monitor, and evaluate the WIGOS implementation process.

Given the significance of active cooperation and enhanced coordination among the technical commissions, regional associations, and WMO partners, appropriate steps will need to be taken to ensure that the integration process is incorporated in the work programmes and implementation plans of these entities. For this purpose, during the WIGOS Implementation Phase, it is highly desirable that an Inter-Commission Coordination Group on WIGOS (ICG-WIGOS) be established.

Furthermore, for WIGOS to be successful, it will be necessary to identify terms of reference for task teams at the regional and commission levels and, when appropriate, with representatives of partner organizations. Major tasks should be assigned as follows:

- Regional task teams will need to coordinate planning and implementation of WIGOS on the regional level with WIS implementation and, eventually, with the implementation of GFCS in order to optimize regional and national observing systems;
- Inter-Commission Task Teams, which should include representatives of partner organizations, will need to address standardization, observing system interoperability, data compatibility, data management, QMS procedures, performance monitoring, WMO regulatory material issues, and proposed improvements in observing networks/systems.

Improving coordination will be an ongoing activity at policy, technical, and Secretariat levels. This will need to be supported by a high-level reconciliation mechanism defined in the WMO-UNESCO-IOC-UNEP-FAO-ICSU Memoranda of Understanding (MOU) to address data policy, product delivery, and other governance issues.

These interagency and inter-observing system coordination mechanisms will need to be complemented and supported through similar cooperation and coordination arrangements among NMHSs and through national implementation mechanisms for GCOS, GOOS, GTOS, and GEOSS.

5.2.10 Resources

Initial investment will be required by Members during the WIGOS Implementation Phase (2012-2015) as detailed in WDIS/WIP. Once WIGOS enters its Operational Phase, WIGOS will enable Members to operate and evolve their observing systems in a more cost effective manner.

5.3 Principles and Assumptions

The WIGOS concept relies on a set of principles and assumptions that are derived from WMO operational policies or are inherent in an environment of co-sponsored systems.

The following principles should be taken into account:

- WIGOS development and implementation will cause no harm or limitation to the existing WMO or co-sponsored observing systems;
- Different levels of development as well as diversity of Member's capabilities, needs and available resources will have to be taken into account;
- Acquisition of additional funding and resources will require continuous efforts on national and international levels.

The implementation of WIGOS assumes that:

- The WIGOS integration process will be a complex, evolving and challenging undertaking; it will require significant support of WMO Members to be successful;
- The concept of WIGOS is based on the premise that the general standards and recommended practices, as agreed-upon for WIGOS, will apply to all WMO and, to the extent possible, co-sponsored observing systems. Strong collaboration, cooperation and coordination are needed among all partners to achieve maximum commonality of standards and practices across the co-sponsored observing systems;
- The continuing sense of ownership by the various groups that have initiated and developed the individual observing system components through directly involving these groups in the planning and implementation of the WIGOS will be guaranteed;
- Significant technical innovation and capacity-building, communication and outreach activities will be essential to take advantage of WIGOS benefits, especially in the case of developing countries and LDCs (see WDIS for more details).

6 OPERATIONAL POLICY CONSIDERATIONS

Many of the building blocks (see Section 5) of the future operation of WIGOS already exist and are of high value to current users. It is recognized that proper interaction between WIGOS observing components with respect to data management and standardization necessitate an unprecedented level of coordination and collaboration among the owners of the observing systems.

6.1 Data policy

WIGOS will respect the data policies of partner organizations and will adhere to the decisions of the Twelfth and Thirteenth World Meteorological Congresses (1995, 1999) that adopted Resolution 40 (Cg-XII) "WMO Policy and Practice for the Exchange of Meteorological and Related Data and Products including Guidelines on Relationships in Commercial Meteorological Activities" and Resolution 25 (Cg-XIII) "Exchange of Hydrological Data and Products" respectively.

WIGOS will strive to ensure that the conditions placed by the originator on the additional data and products are respected and made known to initial and subsequent recipients for the exchange of

meteorological and related data and products, including guidelines on relationships in commercial meteorological and hydrological activities.

Since there are differences among existing policies of partner organizations, it may not be possible to integrate them into one single Data Policy. In this connection WIGOS Data Policy should be preferably composed of two main parts, the first defining common policies and the second specifying individual data sharing principles and practices of all WIGOS partners.

Common WIGOS Data Policies

- The common policies could be seen as a minimum set of commonly agreed principles, adopted by consensus of all partners. In this way WIGOS partners would retain their full autonomy;
- Major commonality of WIGOS partners' data policies relate to the provision of data (and metadata) for non-profit, scientific and/or educational purposes. Special consideration to research and education could be described in this part of WIGOS Data Policies;
- Many partners' data policies also refer to the full and open access (exchange) of data and metadata with minimum time delay, free of charge or at the cost of no more than the cost of reproduction and delivery. There may be, however, partners that do not fully recognize these principles but may be willing to reconsider and expand their current policies and these would require appropriate level of negotiation.

Individual data sharing principles and practices

- It would be inappropriate to enforce or otherwise make mandatory any policy by WIGOS to its partners. The participation in WIGOS is voluntary. Some partners have generic policies while others have quite complex policies and practices. All partners taking part in WIGOS should do all they can to improve availability and delivery of their observational data and products.

6.2 Relationship between WMO and co-sponsored observing systems

Effective implementation and operation of WIGOS will require enhanced collaboration of WMO with partner organizations (UNESCO and its IOC, UNEP, FAO, and ICSU) with whom it co-sponsors GOOS, GTOS and the cross-domain GCOS. This will be necessary in order to ensure essential interoperability and mutual support, while also respecting and reinforcing the individual identities and mandates of both the partners and their co-sponsored observing systems. It will also require a clear understanding, at both international and national levels, as to how WIGOS, GCOS, GOOS and GTOS fit together within the overall framework of GEOSS.

By virtue of WMO's co-sponsorship of the IOC-led GOOS and the FAO-led GTOS, those parts of these systems which contribute to, or support, WMO research and service programmes**,** are appropriately regarded as contributions to WIGOS. Every effort should be made, therefore, to achieve full interoperability and mutually supportive advisory and coordination arrangements with both GOOS and GTOS.

Similarly, the jointly-sponsored, cross-cutting GCOS, which is made up primarily of the climate-relevant components of WMO observing systems, GOOS and GTOS, will need to be implemented and operated on the basis of maximum possible complementarity and mutual support between GCOS and its component systems.

Improving coordination will be an ongoing activity at policy, technical, and Secretariat levels. This will need to be supported by a high-level reconciliation mechanism defined in the WMO-UNESCO-IOC-UNEP-FAO-ICSU Memoranda of Understanding (MOU) in order to resolve possible problems in data policy, product delivery, and other governance issues. The existing Interagency Coordination and Planning Committee for Earth Observations (ICPC) should be strengthened and used for such coordination activities.

These interagency and inter-observing system coordination mechanisms at the international level will need to be complemented and supported through similar cooperation and coordination arrangements

between NMHSs and their counterpart national implementation mechanisms for GCOS, GOOS, GTOS and GEOSS.

6.3 Science Support

New technology and scientific knowledge is required to meet WIGOS user requirements. Both hypothesis-driven and mission-driven research is of fundamental importance to the evolution of WIGOS as a fully integrated system. Observing System Experiments (OSEs) and Observing System Simulation Experiments (OSSEs) carried out by leading NWP centres will be key factors to support advances in operational capabilities of WIGOS related to the best mix of observing systems and to give advice to WMO Members on ways forward.

WMO's science experiments, such as THORPEX and AMMA, are providing insights into the value of targeted observational strategies and observing system considerations which are important to the design and implementation of WIGOS.

7 IMPACTS AND IMPLICATIONS

Cg-XV emphasized that integration in the context of WIGOS would have an impact on the structure and functions of WMO, on international collaboration, cooperation and coordination as well as direct consequences to national programmes and activities. Therefore, awareness of potential impacts would be essential for NMHSs and other national/international agencies operating observing networks to ensure understanding and accepting the WIGOS design and its implementation.

7.1 Impacts on WMO

For the purpose of integration in the context of WIGOS, appropriate organizational, programmatic, procedural, and governance structures will enable a common standardization approach and uniform implementation of WMO regulations and practices. This will ensure data integration and interoperability across all WMO observing systems.

7.2 Operational impacts

Operational impacts will comprise step-by-step implementation resulting in better:

- Standardization, interoperability and data compatibility arrangements in operational observing networks and systems;
- Procedures for improved quality, traceability and consistency of observations (recommendations on instruments and methods of observation);
- Procedures for the generation of observational data, products and associated metadata from WIGOS observing–components using comprehensive, standardized data and metadata representation in compliance with WIS information exchange requirements for all WMO and co-sponsored Programmes;
- Quality management system and data/metadata management procedures;
- Procedures and processes of performance monitoring, evaluation, feedback and corrective actions.

Potential operational impacts may also include introducing new modes of operation based on emergency, disaster or accident conditions and changes in the operational budget.

Other impacts will include:

- The commitment of additional resources (funding, staff, time) by Members, partner Organizations and the WMO Secretariat to efforts addressing WIGOS development and implementation;
- Adjusting relationships between WMO and co-sponsored observing systems (e.g. changes in

MoUs etc.);

- User involvement in extended capacity building activities and technology transfer.

8 LIST OF ACRONYMS

AMDAR	Aircraft Meteorological Data Delay
AMMA	African Monsoon Multidisciplinary Analysis
BSRN	Basic Surface Radiation Network
CBS	WMO Commission for Basic Systems
CEOS	Committee on Earth Observation Satellites
CGMS	Coordination Group for Meteorological Satellites
CONOPS	Concept of Operations
EC WG	Executive Council Working Group
EUCOS	EUMETNET Composite Observing System
EUMETNET	The network of European National Meteorological Services
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
FAO	Food and Agriculture Organization
GAW	Global Atmospheric Watch
GCOS	Global Climate Observing System
GEOSS	Global Earth Observation System of Systems
GFCS	Global Framework for Climate Services
GOOS	Global Ocean Observing System
GOS	Global Observing System
GRUAN	GCOS Reference Upper-Air Network
GTOS	Global Terrestrial Observing System
ICG-WIGOS	Inter-Commission Coordination Group on WIGOS
ICG WIS	Inter-Commission Coordination Group on WIS
ICPC	Interagency Coordination and Planning Committee for Earth Observations
ICSU	International Council for Science
IOC	Intergovernmental Oceanographic Commission
ISO	International Standards Organization
JCOMM	Joint WMO/IOC Commission for Oceanography and Marine Meteorology
MOU	Memorandum of Understanding
NMHS	National Meteorological and Hydrological Service
NWP	Numerical Weather Prediction
OPAG IOS	CBS Open Programme Area Group on the Integrated Observing System
QA	Quality Assurance
QC	Quality Control
QMF	Quality Management Framework
QMS	Quality Management System
R&D	Research and Development
RRR	Rolling Review of Requirements
SOG	Statement of Guidance
TC	Technical Commission
THORPEX	The Observing System Research and Predictability Experiment
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WDIP	WIGOS Development and Implementation Plan
WHYCOS	World Hydrological Cycle Observing System
WIGOS	WMO Integrated Global Observing System
WIS	WMO Information System
WWW	World Weather Watch

Appendix V

WORLD METEOROLOGICAL ORGANIZATION

WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

WIGOS DEVELOPMENT AND IMPLEMENTATION STRATEGY

(WDIS)

Version 1.2

DOCUMENT VERSION CONTROL

Version	Author(s)	Date	Description
0.1	WIGOS-PO	Feb 2010	Reviewed by senior OBS staff
0.2	WIGOS-PO	Feb 2010	Reviewed and approved by D/WIGOS (D/OBS)
0.3	WIGOS-PO	March 2010	Feedback from CBS, CIMO, GCOS, senior consultants
0.4	CBS/CIMO	March 2010	Feedback from CBS-CIMO/WIGOS-CM
0.5	EC-WG	March 2010	Decision by EC-WG/WIGOS-WIS-3
0.6	WIGOS-PO	April 2010	Feedback from EC-WG/WIGOS-WIS
1.0	EC-LXII	June 2010	Approval of version 0.6
1.1	WIGOS-PO	Oct 2010	Feedback from the Secretariat and SG-WIGOS-3
1.2	WIGOS-PO	Feb 2011	Decision by EC-WG/WIGOS-WIS-4

CONTENTS

EXECUTIVE SUMMARY

The WMO Strategic Planning process, approved by the Fifteenth World Meteorological Congress (Cg-XV) (Geneva, May 2007) guides the Organization in delivering its contributions to desired societal outcomes. The WMO Integrated Global Observing System (WIGOS) and the WMO Information System (WIS) are strategic initiatives of WMO and were included in a set of eight high-level Expected Results (ERs), in particular "Enhanced capabilities of Members to access, develop, implement and use integrated and interoperable surface-based and space-based systems for weather, climate and hydrological observations, as well as related environmental observations, based on world standards set by WMO and partner organizations". The success of WIGOS and WIS will have a major impact on all WMO Strategic Thrusts.

Based on the WMO strategic planning principles, the WIGOS Development and Implementation Strategy (WDIS) was developed in accordance with a decision of the WMO Executive Council in 2009 (EC-LXI). This decision emphasized the importance of WIGOS to WMO Members for integrating WMO observing systems and for strengthening linkages with co-sponsored observing systems.

The objective of this strategy is to describe the steps that WMO, in collaboration with partner organizations, will follow to improve governance, management, and integration of WMO observing systems, and their contributions to co-sponsored systems, so as to ensure a coordinated, comprehensive, and sustainable system that meets the requirements of WMO Members and partner organizations. The Implementation Phase (2012-2015), described in WDIS, builds on lessons learned from the Test of Concept Phase (2007-2011) and lays the groundwork for the Operational Phase (from 2016 onward). As with WIS, the establishment of a WIGOS Project Office is essential to support the implementation phase.

In implementing WIGOS, it is imperative that the current management, governance and support activities be reviewed and aligned with WMO strategic planning and results-based management. This alignment should enable collaboration and promote cooperation and coordination at the technical, operational and administrative levels.

Achieving the benefits of WIGOS will require commitment from WMO Members, constituent bodies and from partner organizations who have agreed to collaborate in the implementation of WIGOS. Progress in WIGOS implementation will be directly related to the level of available resources. To move forward, substantial support to the Secretariat during the next financial period is required for the Implementation phase. If the requested resources are not made available, WIGOS implementation will be put at substantial risk.

Given the significance of active cooperation and enhanced coordination among technical commissions, regional associations and WMO partners, appropriate steps will need to be taken to ensure that the integration process is incorporated in the work programmes and implementation plans of these entities. Both, regional associations and technical commissions will play a fundamental role in this process.

An integrated global observing system, supported by an interoperable information system is essential to realizing the socio-economic benefits to be derived from a wide range of weather, climate, water and related environmental products and services. WIGOS will be an essential component of WMO's results-based management. It will ensure a coordinated WMO contribution to the cosponsored GOOS and GTOS and will be key to the successful implementation of GCOS in support of the UNFCCC, and in the development and implementation of the Global Framework for Climate Services (GFCS). Through WIGOS and WIS, and their support for GOOS, GTOS and GCOS, WMO will make a fundamental contribution to the success of the Global Earth Observation System of Systems (GEOSS).

1 INTRODUCTION

The success of the past

For over 60 years WMO, through its Members, has advanced the observing and monitoring of weather, climate, water and the environment. This has led to a better understanding of the Earth System, and resulted in the delivery of improved and expanded services such as weather and air-quality forecasts, climate outlooks and predictions, and hydrological forecasts and assessments, which have resulted in improved decision making. These services now expand across timescales from severe weather warnings to weekly forecasts to seasonal outlooks, inter-annual and decadal variations and long-term climate change projections with broad applications across social and economic sectors worldwide.

WMO has built productive alliances with partners that address the observational and monitoring needs associated with intersecting domains, particularly in respect of the climate system.

The challenge for the future

WMO Members need more timely, comprehensive and advanced observations and information to improve both service quality and service delivery. An increasingly sophisticated user community is demanding that information reflects not only the complexity of the Earth's environment, but that it be delivered in such a way that can influence decision making at multiple scales. The challenge today is to achieve such ambitious results in a cost-effective manner. The WMO Integrated Global Observing System (WIGOS) is a key strategic initiative to optimize the efficiency and effectiveness of WMO services, leveraging the long-standing collaborative culture of WMO as well as new technologies and building on the investment by WMO and partner organizations in co-sponsored observing systems.

To meet this challenge, WMO Members must continue their legacy of integrated global observations and information. In doing so, observations and information from other domains, other observing systems, and other partners will be essential. Partnership agreements, governance structures, and interoperability arrangements among all of the above will present their own challenges. WIGOS and WIS must take full advantage of advances in observation and telecommunication technologies and in existing governance structures in order to increase science-based understanding of the Earth and its environment. The end result will be better prediction and services that provide the required information for the public and for policy and decision makers to ensure that national and international investments are being leveraged to the greatest extent possible.

2 BACKGROUND

2.1 WMO Strategic Planning

The WMO Strategic Plan recognizes that understanding the state of the environment is essential, and it depends upon the collection and open sharing of information, often using rapid and highly reliable methods.

The implementation of WIGOS will be an essential component of WMO's results-based management to address identified global societal needs. These needs consist of: (1) improved protection of life and property; (2) poverty alleviation, sustained livelihoods and economic growth; and (3) sustainable use of natural resources and improved environmental quality. WIGOS will contribute to all WMO Expected Results of the 2012-2015 Strategic Plan and is fundamental to the Strategic Thrust I "Improving Service Quality and Service Delivery".

In particular, WIGOS will deliver Expected Result 4, "Enhanced capabilities of Members to access, develop, implement and use integrated and interoperable surface-based and space-based systems for weather, climate and hydrological observations, as well as related environmental observations, based on world standards set by WMO and partner organizations". The success of WIGOS will have a major impact on all WMO Strategic Thrusts areas.

2.2 WIGOS Initiative

The concept of WIGOS, as adopted by the Fifteenth World Meteorological Congress (Resolution 30, Cg-XV, 2007), originated from the widespread recognition that establishment of a coordinated approach to the management of diverse WMO observing systems would result in substantial benefits and efficiencies for Members and stakeholders.

Cg-XV requested that the development of WIGOS proceed concurrently with the planning and implementation of the WMO Information System (WIS). The combination of both efforts would allow for an integrated WMO end-to-end system designed to improve Members' capabilities to effectively provide a wide range of high quality services and to better respond to all WMO Programmes requirements.

As noted by Cg-XV, WIGOS as it evolves will impact the structure and function of WMO, including the WMO Programme structure, roles and responsibilities, terms of reference and working arrangements of technical commissions, the WMO Technical Regulations, and the WMO Secretariat.

In 2009, the Executive Council (EC-LXI) noted the value of including all observing systems important to the National Meteorological and Hydrological Services (NMHSs) in a single organizational framework. It emphasized the need for a comprehensive, costed development and implementation strategy to address the technical and coordination challenges. This Strategy would include the designation of roles and responsibilities of WMO entities and partner organizations[1)] and the requirements for capacity building so that all WMO Members and partner organizations can benefit from WIGOS. The Strategy would also provide guidance to ensure enhanced coordination in four key areas: within WMO, with partners, with users and with the science and technology communities.

In response to Cg-XV and the Executive Council, the WMO Technical Commissions (TC), Regional Associations (RA) and the Secretariat during the period 2007-2011 explored the concept of WIGOS through a series of Pilot Projects (by the technical commissions, sometimes in collaboration with partner organizations) and Demonstration Projects (by Members and the regional associations). This document builds on the lessons learned in the current Test of Concept Phase.

Based on the Test of Concept Phase of WIGOS, the basic characteristics of WIGOS are specified in the WIGOS Concept of Operations (CONOPS) document, which describes user needs for, and expectations from, the proposed system and how the system should operate to fulfil those needs. This document provides a logical transition of WIGOS from initial to full operational capabilities, recognizing that CONOPS will continue to be refined and will remain a basic reference document to this Strategy.

2.3 Vision

The WIGOS Vision calls for an integrated, coordinated and comprehensive observing system to satisfy, in a cost-effective and sustained manner, the evolving observing requirements of WMO Members in delivering their weather, climate, water and related environmental services. WIGOS will enhance the coordination of WMO observing systems with those of partner organizations for the benefit of society.

WIGOS will provide a framework for enabling the integration and optimized evolution of WMO observing systems, and WMO's contribution to co-sponsored systems. Together WIGOS and WIS will allow continuous and reliable access to an expanded set of environmental data and products and associated metadata, resulting in increased knowledge and enhanced services across all WMO activities.

[1)] In this document "partner organizations" means intergovernmental, non-governmental and international organizations and groupings that operate, or co-sponsor with WMO, observing systems that contribute to WIGOS. The main partner organizations are UNESCO and its IOC, UNEP, FAO and ICSU and the main co-sponsored observing systems are GCOS, GOOS and GTOS; partner organizations also include GEO.

2.4 Requirements and Objectives

To enable improved service delivery, there is a need to improve the existing observing capabilities, make them more cost-effective and sustain their operation. To ensure a coordinated, comprehensive, and sustainable system that meets the requirements of WMO and partners, improved governance, management, and integration of observing systems is needed.

Integration must be pursued to ensure interoperability and facilitate optimization across observing components. WIGOS will also enable resources to be used more effectively to overcome existing deficiencies and gaps in the observing components.

WIGOS is expected to provide timely, quality-assured, quality-controlled and well-documented long-term observations. Implementing Quality Management procedures is required to enable better utilization of existing and emerging observing capabilities.

In responding to evolving user requirements, WIGOS and WIS will meet the following objectives:

- Enable WMO Members to better respond to natural hazards, improve weather, water, climate and related environmental monitoring, adapt to climate change and human-induced environmental impacts and meet expanding national mandates while achieving higher national visibility with other environment related agencies;
- Ensure a coordinated WMO contribution to the cosponsored GOOS and GTOS and contribute to the successful implementation of GCOS in support of the UNFCCC, and in the development and implementation of the Global Framework for Climate Services (GFCS);
- Strengthen WMO's contribution to GEOSS;
- Provide a basis for sound decision making and enhance delivery of benefits to society.

An integrated global observing system, supported by an interoperable information system, will be a key contribution in realizing the socio-economic benefits to be derived from a wide range of weather, climate, water and related environmental products and services.

2.5 Scope

In meeting its objectives, WIGOS will not only serve WMO Members and partners but will also make a major and unique contribution to United Nations agencies that are focused on environmental stewardship, and along with WIS, will be a core contribution of WMO to GEOSS.

To achieve the objectives, which were demonstrated in the Test of Concept Phase, the scope of WIGOS will encompass the following:

- *Requirements:* Provide a mechanism to meet evolving observing requirements of WMO Members and WMO partner organizations building on the existing Rolling Review of Requirements (RRR) process;
- *Integration:* Build upon and add value to the existing WMO observing components of Global Observing System (GOS), Global Atmosphere Watch (GAW), and World Hydrological Cycle Observing System (WHYCOS) with emphasis on integration of surface- and space-based observations;
- *Standardization:* Enhance observational data and product quality and homogeneity by introducing improved data quality and data management standards to better satisfy user requirements;
- *Access:* Improve access to, and utilization of, observations and products from WMO observing systems as well as those of co-sponsored systems;
- *Coordination:* Foster research and development activities and coherent planning for future observing systems and network optimization by working with all WMO Programmes and partner organizations.

2.6 Phases

The Test of Concept Phase (2007 - 2011)

The development of WIGOS and its coordination with the development and implementation of WIS has been overseen by the Executive Council Working Group on WIGOS and WIS (EC-WG/WIGOS-WIS) established by EC (Resolution 3, EC-LIX, 2007). The EC-WG/WIGOS-WIS established a Subgroup on WIGOS (SG-WIGOS) to manage technical integration activities, the development and implementation of the WIGOS concept, and to provide recommendations to EC-WG/WIGOS-WIS. The Secretariat has provided support to EC-WG/WIGOS-WIS and SG-WIGOS.

In accordance with the recommendation of Cg-XV, development and implementation of the WIGOS concept proceeded in the phases defined by the annual sessions of the Executive Council. The WIGOS Test of Concept Development and Implementation Plan (WDIP) with the Strategic Roadmap was developed by EC-WG/WIGOS-WIS, taking into account the WIS Project and Implementation Plan, and updated annually.

The seven Pilot Projects, initiated by the technical commissions, addressed major issues of the integration process, including testing the WIGOS concept and identifying problem areas. Lessons learned emphasized the role and contributions to be made by the technical commissions and relevant partners in the integration process.

In accordance with recommendations by EC-LX, several Demonstration Projects were initiated by WMO Members. At least one 'test-bed' Demonstration Project was carried out within each RA. Feedback and lessons learned from Demonstration Projects facilitated the understanding of expectations on WIGOS at national and regional levels, including importance of capacity-building activities.

The status of implementation of WIGOS Pilot and Demonstration Projects is posted on the WIGOS Web page at http://www.wmo.int/pages/prog/www/wigos/index_en.html as a communications and outreach activity.

WIGOS Implementation phase (2012-2015)

The Implementation phase, to be undertaken between 2012 and 2015, will focus on developing and implementing a framework for improved governance, management, integration and optimization of the multiple observing systems coordinated by WMO and its partner organizations.

WIGOS Operational Phase (2016 onward)

Once this framework is established, WIGOS will enter its Operational Phase. During this phase, WIGOS observing components will continue to evolve to improve service delivery and support decision making in response to the evolving needs of users and technological opportunities. Although this phase is not limited in time, it is anticipated to include an initial period of rapid enhancement of observing capabilities between 2016 and 2019 in order to meet the highest priority needs.

3 WIGOS IMPLEMENTATION COMPONENTS

In light of the crosscutting nature of WIGOS and its impact on an organizational process and structure identified by Cg-XV, the success of WIGOS must not be detrimental to the ongoing maintenance and operational effectiveness of existing observing systems or to their governance. In order to manage these risks (see Section 4.2), the key implementation components for this Strategy must include:

1. Integrated governance;
2. Data delivery and information services through WIS;
3. Quality management, including monitoring and standardization;

4. Planning and optimization of observing systems;
5. Capacity building;
6. Communications and outreach.

A brief description of the major implementation aspects is given in the following paragraphs.

3.1 Integrated Governance

WIGOS will address high-level observing requirements by establishing the effective and sustained organizational, programmatic, governance and procedural structures. These structures will enable a common standardization approach, uniform implementation of WMO regulations, and data integration and interoperability across all WMO observing systems. It will also provide a single focus for integrated and coordinated operational management of all WMO observing systems and a mechanism for coordination with WMO co-sponsored and contributing observing systems.

Therefore, in implementing WIGOS it is imperative that the current management, governance and support activities be reviewed and aligned with WMO strategic planning and results-based management. This alignment should enable collaboration and promote cooperation and coordination at the technical, operational and administrative levels.

Central coordination through the WMO Secretariat is essential for successful WIGOS implementation. In addition, the long-term commitment and effort of WMO Members; greater international cooperation; and sustained technological, capacity building, and financial support for developing and least developed countries is important.

The development of an effective and efficient system of governance will require adequate scientific and technical advisory mechanisms to develop, monitor, and evaluate the WIGOS implementation process. The WMO Executive Council will continue to monitor, guide and support the implementation of WIGOS.

Given the significance of active cooperation and enhanced coordination among the technical commissions, regional associations, and WMO partners, appropriate steps will need to be taken to ensure that the integration process is incorporated in the work programmes and implementation plans of these entities. For this purpose, it is highly desirable that an Inter-Commission Coordination Group on WIGOS (ICG-WIGOS) be established. This group would replace the Subgroup on WIGOS and would be expected to:

- Coordinate, review, refine, and assess the development and implementation of WIGOS;
- Provide technical guidance and assistance for the WIGOS development, planning, and implementation activities, such as standardization and development of WIGOS databases;
- Advise regional associations on WIGOS implementation activities;
- Advise technical commissions on the standardization process and related activities;
- Coordinate cooperation at a technical level with WMO partner organizations, including UNESCO and its IOC, UNEP, FAO, and ICSU (who would be invited to participate in this activity);
- Coordinate the WMO contribution to GOOS, GTOS, GCOS and GEOSS;
- Address major issues identified by EC; Advise EC on further development and implementation of WIGOS; Report to EC;

Furthermore, for WIGOS to be successful, it will be necessary to identify terms of reference for task teams at the regional and commission levels and, when appropriate, with representatives of partner organizations. Major tasks should be assigned as follows:

- Regional task teams will need to coordinate planning and implementation of WIGOS on the regional level with WIS implementation and, eventually, with the implementation of GFCS in order to optimize regional and national observing systems;

- Inter-Commission Task Teams, which should include representatives of partner organizations, will need to address standardization, observing system interoperability, data compatibility, data management, Quality Management System (QMS) procedures, performance monitoring, WMO regulatory material issues, and proposed improvements in observing networks/systems.

Improving coordination will be an ongoing activity at policy, technical, and Secretariat levels. This will need to be supported by a high-level reconciliation mechanism defined in the WMO-UNESCO-IOC-UNEP-FAO-ICSU Memoranda of Understanding (MOU) in order to resolve possible problems in data policy, product delivery, and other governance issues. The existing Interagency Coordination and Planning Committee for Earth Observations (ICPC) should be strengthened and used for such coordination activities.

These interagency and inter-observing system coordination mechanisms will need to be complemented and supported through national coordination arrangements among NMHSs and their partner organizations and coordinated with similar national implementation mechanisms for GCOS, GOOS, GTOS, and GEOSS.

Data Policy

A key part of integrated governance will be to achieve compatible, and as far as practical, consistent data policies. WIGOS will respect the data policies of partner organizations and will adhere to Resolution 40 (Cg-XII) and Resolution 25 (Cg-XIII). It will strive to ensure that the conditions placed by the originator on the additional data and products are respected and made known to initial and subsequent recipients for the exchange of weather-, climate-, and water-related data and products, including guidelines on relationships in commercial meteorological and hydrological activities.

Although data policies are similar across WIGOS contributing organizations, there are some differences. Therefore, it may be necessary to follow a two-fold approach, consisting of a common set of data sharing principles supplemented by specific practices of those contributors.

3.2 Data Delivery and Information Services through WIS

The WIGOS pilot projects, such as the JCOMM/IODE Ocean Data Portal and the CAS/GAW projects, have supported the effectiveness of WIS as the core interoperability layer of WIGOS. WIS allows otherwise independent observing systems to move data between them, as well as providing the standards for more effective data management. WIS also supports the collection and sharing of observations and products within WIGOS and allows new initiatives such as the enhanced climate services being developed under the framework of GFCS to benefit easily from WIGOS data and products. A detailed description of WIS is presented in the WIS Project and Implementation Plan.

As noted by EC-LXI (2009), WIGOS is crucially dependant upon effective WIS support and services and should proceed in close coordination with WIS implementation. This includes the specialized data collection means as well as the generation, collection, management and handling of related metadata [2)] that is essential to ensuring data within WIGOS meet the stringent traceability requirements of special users such as climate scientists. The metadata also play an important role in the discovery and access to observations and products. The needed metadata therefore includes both that which pertain to the observational information as well as that which describes the observational products and which is necessary to share the information.

3.3 Quality Management and Standardization

Quality Management, including monitoring

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2) It is necessary to clearly distinguish between station/platform metadata (“WIGOS metadata”) and WIS metadata needed for Data Discovery, Access and Retrieval (DAR) services that WIS must provide. Both are essential to WIGOS.

Meeting the quality requirements and expectations of users is critical to the success of WIGOS. This will require an in-depth examination of current practices used by WMO observing programmes, specific mission-related requirements that are already in place, and available technological opportunities. It will also be important to review the quality not only of the deliverables produced by WIGOS but also of the management processes involved.

WIGOS should embrace QMF procedures to ensure that observations, records and reports on weather, water, climate and other environmental resources, operational forecasts, warnings, related information and services are of identified quality, and in compliance with relevant joint standards agreed upon with other international organizations.

This should be based on agreed-upon quality assurance and quality control standards, with the goals of developing and implementing an integrated QMS; in doing this, and only after effective national implementation, it will deliver reliable and timely data streams with adequate quality control and relevant metadata.

WIGOS QMF implementation strategy will specify all processes of QMS for observing networks. Attention will also be paid to the guidance on how to monitor and manage observing networks and observing subsystems to fully meet QMF requirements.

Standardization

As specified in CONOPS, a principal requirement for integration is the standardization in three key areas: Instruments and Methods of Observation; WIS information exchange and discovery; and Quality Management Framework.

As a part of the implementation strategy, a successful WIGOS standardization process will have to adequately address the differences and inconsistencies in current technical specifications, data acquisition and management systems used by individual NMHSs and partner organizations before national and international observing systems can be regarded as truly integrated.

3.4 Planning and Optimizing of Observing Systems

Coordinated planning based on the RRR process has a great potential to enhance observing system capabilities and to increase cost-effectiveness of observing efforts and investments.

This activity will be performed through the following:

- A systematic rolling review of observing requirements from each of the user communities WIGOS intends to serve, and maintain a consolidated and evolving set of requirements;
- A regular review of the observing capabilities that are actually implemented, and a continuous monitoring of their performances;
- A review of emerging capabilities and the potential of new technology to replace or complement current observing capabilities.

This process, conducted with close involvement of both the operational and research communities, should result in Statements of Guidance for all application areas in which observations are used to support WMO programmes. Key gaps in observing capabilities identified by the Statements of Guidance will result in proposals for activities to fill these gaps.

The coordinated planning of the evolution and enhancement of observing systems in response to these Statements of Guidance must be conducted in a coordinated way across observing systems, as far as practical, through systematic exchange of information, consultation, with the aim to develop synergy. This shall be pursued when defining sensor specifications, locations and operating mode, when sharing observation infrastructure and organizing data management and distribution. The role of RAs and TCs will be indispensable in the overall process.

3.5 Capacity Building

An effective capacity-building and training strategy is an essential component of the WIGOS. A coordinated capacity-building effort should assist developing and least developed countries to improve and sustain their contributions to WIGOS observing systems, including access to and effective utilization of observations, data and products, and related technologies. As a key factor in successful WIGOS implementation, capacity building activities at national and regional levels will be focused on:

- Institutional mandates and policies;
- Infrastructure establishment and/or strengthening;
- Human skills development and training;
- Technical assistance; and
- Technology transfer.

To take advantage of WIGOS benefits and to ensure that information and services are used to the maximum extent possible, transfer of technological innovations and development of decision support tools will be essential. For this purpose, specialized education and training activities should be reflected in the Regional WIGOS implementation plans, especially for NMHSs of Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

3.6 Communications and Outreach

Given numerous and geographically diverse stakeholders, development and implementation of a WIGOS communications and outreach strategy will be one of the key prerequisites to the success of WIGOS. This strategy should comprise the following core areas:

- Interaction of the WIGOS Project Office with the secretariats of the various WMO and WMO-co-sponsored observing systems and user programmes. The Office should also coordinate with related activities such as the Polar Observations, including the Global Cryosphere Watch, GCOS and GEOSS, and with the coordinated WMO contribution to the GFCS;
- Active involvement of RAs and TCs. The WIGOS development and implementation strategy includes establishment of regional/inter-commission expert teams. These teams will participate in the development and implementation of WIGOS at the regional/ technical commission levels;
- Establishment and management of a WIGOS portal. This portal will provide relevant information to stakeholders on WIGOS development, implementation, and standardization processes and on the communications and outreach strategy;
- Proactive identification of new users as WIGOS evolves.

A comprehensive communication strategy will help Members to understand the challenges they face in implementing WIGOS at national and regional levels and increase awareness of the technical guidance and other mechanisms that will be developed to assist and support them.

4 WIGOS IMPLEMENTATION MANAGEMENT

4.1 Implementation Environment

The development and testing of the WIGOS concept after Cg-XV occurred during a long and very challenging global economic recession. This situation affected many NMHSs that had already been facing reduced budgets and therefore greater pressure to reduce operational and maintenance costs. The Test of Concept Phase of WIGOS has also occurred alongside a rapidly increasing interest in climate change. Moreover, climate assessments require far more vigilance in addressing the sustainability and long-term homogeneity of data being used to assess climate variability and change.

The financial crisis and competing priorities have the potential to divert funds from core observing systems at a time when they are most needed to meet society's needs. There is also considerable competition for funds between traditional *in situ* and space-based observations. While advances in numerical modelling and assimilation processes clearly show the benefits of remote sensing to weather and climate models, they also highlight the important complementarity provided by *in situ* observations. Therefore WIGOS will have to be supported by appropriate awareness raising and outreach activities that reinforce the importance of both *in situ* and space-based observations and their integration.

For WIGOS to succeed, the external environment as well as the risks associated with the integration of previously independent systems must be managed. In particular, there is a need for the WIGOS Project Office with sufficient staffing and funding to carry out the necessary tasks detailed in Section 3 and reflected in the deliverables in Section 4 (see Figure 1). Noting that there is already one person in the WIGOS Planning Office, it is recommended that at least two additional staff be provided.

4.2 Risk Assessment

An initial risk assessment identifies the implementation of WIGOS as a high risk project for the following reasons:

- ***Complexity of the project***. The project involves diverse stakeholders and needs a high level of cooperation among them. Implementation activities must be integrated into the strategic planning of RAs as well as that of individual Members to ensure connectivity and to encourage synergies between national, regional and global activities;
- ***Basic infrastructure***. This must be in place to allow improved data acquisition systems, data management systems, and QMS to function effectively;
- ***Resources***. Substantial investment of resources and expertise are needed to support WIGOS development and implementation.

Following EC-LXII, a skeletal WIGOS Implementation Plan will be formulated utilizing CONOPS, WDIP and WDIS. This will be submitted for approval by the President on behalf of the EC for transmission to Cg-XVI. Between Cg-XVI and Cg-XVII, a complete WIGOS Implementation Plan (WIP) will be developed including a detailed risk assessment and management plan. Risks will need to be clearly identified and managed at various points throughout the project, including the development of associated mitigation and contingency plans. The Secretariat will take a coordinating role in overall risk management by providing a focal point for these activities.

4.3 Deliverables and Milestones

WIP will address a list of tasks associated with the key deliverables and milestones. The task list should include risk management plans and time lines for each task, along with details of task leaders. Figure 1 shows the key milestones, including routine WIGOS related reports to EC and Congress, and timelines. Some tasks such as coordination with WIGOS component systems will be essential activities throughout and beyond the Implementation phase. The WIGOS project documentation will be a key deliverable early in the period, while Regulatory Documentation will be the focus in later phases. Capacity building will focus on communications and outreach at first and then move to the development of guidelines and training material later in the project. Pilot and demonstration projects will continue to be an important activity in the later implementation stages, especially to assist developing countries including LDCs and SIDS to more fully benefit from WIGOS.

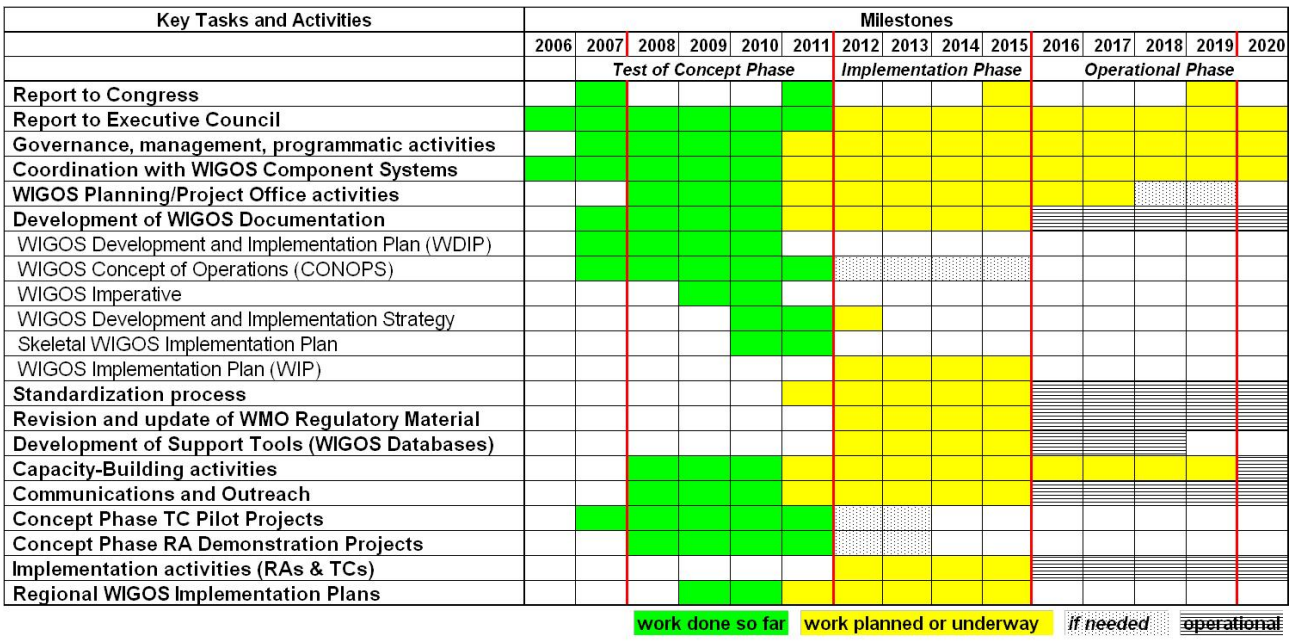

Figure 1: Key Tasks, Activities and Milestones

4.4 Project Monitoring and Review

The EC will continue to monitor, guide and support the implementation of WIGOS. As noted in paragraph 3.1, ICG-WIGOS would ensure coordination across all technical levels.

Depending on the availability of resources, the WIGOS Project Office will provide the operational support to overall WIGOS activities. In addition to supporting ICG-WIGOS, it will support the WIGOS coordination functions of the working bodies of RAs and TCs and other contributing programs and mechanisms. It will continuously monitor WIGOS implementation activities, coordinate follow-up actions and regularly report to all concerned.

All information related to the implementation of WIGOS will be available on the Secretariat WIGOS web portal as a component of the WIGOS communications and outreach strategy.

4.5 Roles and Responsibilities

As requested by Cg-XV, Members, international partner organizations and related programmes have begun to collaborate actively in the development and implementation of the WIGOS initiative. It is recognized that full implementation of WIGOS requires long-term commitments from all participants and mutual understanding by all partners to accomplish their current and planned observational activities in a coordinated manner. WIGOS implementation will require significant effort and time.

In order to move towards full WIGOS operations, the entities listed below are considered to have essential roles and should assume, along with their general terms of reference and their commitment to the implementation of WIS, the following responsibilities:

WMO Members:

- Evolve their observing systems to become their national component of WIGOS,
- Coordinate their WIGOS and WIS implementation activities,
- Provide experts to participate in the WIGOS related work of technical commissions,
- Provide adequate resources to the WMO Secretariat to support WIGOS implementation,
- Support regional and global WIGOS implementation activities,
- Keep the Secretary General informed about their WIGOS implementation activities,

- Share relevant experience and cooperate with one another in implementing WIGOS, including assistance to Members with specific WIGOS-implementation needs.

Executive Council:

- Monitor, guide and support the implementation of WIGOS.

Regional Associations:

- Develop their regional WIGOS implementation plan,
- Coordinate WIGOS implementation activities with WIS in their operating plan and work programme,
- Promote capacity-building and outreach activities to assist Members in the implementation of WIGOS.

Technical Commissions:

- Guide the technical aspects of WIGOS implementation,
- Incorporate WIGOS implementation activities in their operating plan and work programme,
- Provide technical guidance and advice to Members and the Regional Associations on WIGOS,
- Develop guidance for the design and evolution of observing components of WIGOS,
- Develop standards to support WIGOS in collaboration with partner organizations and programmes, including those for metadata,
- Update WMO Regulatory Material, including development of the Manual on WIGOS,
- Provide the technical lead for WIGOS through the Commission for Basic Systems (CBS) and the Commission for Instruments and Methods of Observation (CIMO).

WMO Secretariat:

- Ensure management of, and provide adequate resources in support of the WIGOS implementation,
- Establish the WIGOS Project Office,
- Develop proposals for programmatic and governance structures in support of WIGOS taking into account WMO's strategic directions,
- Ensure proper coordination with other observing systems contributing to the GFCS as it develops,
- Coordinate and collaborate WIGOS activities with UN organizations and other relevant organizations and programmes,
- Support regional associations and technical commissions in developing their WIGOS implementation strategies and projects, including outreach and capacity-building activities,
- Support the review and update of WMO Regulatory Material, including the development of the Manual on WIGOS,
- Work with Members and donors to provide adequate resources for WIGOS implementation.

Partner Organizations:

- Collaborate with WMO in establishing appropriate coordination mechanisms;
- Coordinate with WMO to create and maintain interoperability among observing systems;
- Coordinate with WMO on data policy.

4.6 Resources

It should be underlined that the timely completion of the WIGOS Implementation in the sixteenth financial period 2012-2015 critically depends on adequate resources.

The investment for fully implementing WIGOS should be a significant focus of Member's development and implementation plans. In addition, extra resources will need to be provided through the WMO Secretariat for both staff and non-staff costs for the implementation and coordination that are beyond the normal programmatic activities of the Secretariat. As a result, additional budgetary resources need to be allocated to the WIGOS Implementation Phase.

To ensure the resources needed for WIGOS implementation, the following should be considered:

- WMO Regular Budget for WIGOS implementation support activities;
- WIGOS Trust Funds to supplement WMO Regular Budget;
- In kind contributions;
- Staff secondments;
- Voluntary Cooperation Programme funds for WIGOS related technical cooperation and capacity-building activities;
- Regional fundraising activities to support WIGOS.

Taking into account the role, responsibilities and scope of the work required, the adequately staffed and resourced WIGOS Project Office needs to be established within the Secretariat. This will ensure a suitable project management function, improved coordination and cooperation with TCs, RAs and partner organizations essential for WIGOS implementation.

5 BENEFITS

There is a well-recognized need to improve existing observing capabilities, make them more cost-effective, sustain their operation and enhance service delivery. Integration of respective components and systems must be pursued to ensure interoperability, and optimize WIGOS observing components. WIGOS will enable resources to be used more efficiently and effectively to overcome existing deficiencies and gaps.

WIGOS is expected to provide timely, quality-assured, quality-controlled and well-documented long-term observations. Implementation of Quality Management procedures will be required to enable enhanced utilization of both existing and emerging observing capabilities. In order to meet the evolving user requirements, WIGOS together with WIS will:

- Enable the evolution and integration of WMO observing systems and enhance collaboration with its partner organizations: this will allow access to an expanded set of environmental data and products resulting in increased knowledge and enhanced services (across weather, climate and water domains) in a cost-effective manner;
- Result in enhanced observing capabilities by improving integration between their surface- and space-based components;
- Enable WMO Members to meet expanding national mandates which are calling for increasing coordination and integration to help them better respond to natural hazards, improve weather, water, climate and related environmental monitoring, and adapt to climate change and other human-induced environmental impacts;
- Enhance operational components of WMO Programmes, especially in Developing and Least Developed Countries and ensure essential WMO support for the observational and information elements of the GFCS;
- Contribute strongly to GOOS, GTOS, GCOS and GEOSS; and lastly,
- Provide a basis for sound decision making and enhance delivery of services to society in all WMO applications areas.

An integrated global observing system, supported by an interoperable information system, will be essential for realizing the socio-economic benefits from the wide range of weather, climate, water and related environmental products and services based on WMO's core competencies in environmental monitoring.

LIST OF ACRONYMS

CBS	WMO Commission for Basic Systems
CEOS	Committee on Earth Observation Satellites
CONOPS	Concept of Operations
CIMO	Commission for Instruments and Methods of Observation
CSIS	Climate Services Information System
D/OBS	Director, Observing and Information Systems Department
DMS	Data/metadata management system
DRR	Disaster Risk Reduction
EC	Executive Council
EUCOS	EUMETNET Composite Observing System
EC-WG/WIGOS-WIS	Executive Council Working Group on WIGOS and WIS
FAO	Food and Agriculture Organization
GAW	Global Atmospheric Watch
GCOS	Global Climate Observing System
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GFCS	Global Framework for Climate Services
GOOS	Global Ocean Observing System
GOS	Global Observing System
GTOS	Global Terrestrial Observing System
ICG-WIS	Inter-Commission Coordination Group on WIS
ICG-WIGOS	Inter-Commission Coordination Group on WIGOS
ICPC	Interagency Coordination and Planning Committee for Earth Observations
ICSU	International Council for Science
IOC	Intergovernmental Oceanographic Commission
JCOMM	WMO/IOC Joint Commission for Marine Meteorology
LDCs	Least Developed Countries
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NMHS	National Meteorological and Hydrological Service
QA	Quality Assurance
QC	Quality Control
QMF	Quality Management Framework
QMS	Quality Management System
RA	Regional Association
RRR	Rolling Review of Requirements
EC-WG/WIGOS-WIS	Subgroup on WIGOS
SIDS	Small Island Developing States
TC	Technical Commission
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WDIP	WIGOS Development and Implementation Plan
WDIS	WIGOS Development and Implementation Strategy
WHYCOS	World Hydrological Cycle Observing System
WIGOS	WMO Integrated Global Observing System
WIP	WIGOS Implementation Plan
WIS	WMO Information System
WWW	World Weather Watch

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APPENDIX VI

WORLD METEOROLOGICAL ORGANIZATION

WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

DRAFT *

WIGOS IMPLEMENTATION PLAN

(WIP)

Version 0.3

* The Document presents the draft WIP with proposals for additional text (highlighted in red)

DOCUMENT VERSION CONTROL

Version	Author(s)	Date	Description
0.1	WIGOS-PO	Oct 2010	WIGOS-PO
0.2	WIGOS-PO	Oct 2010	Feedback from SG-WIGOS-3
0.3	WIGOS-PO	Feb 2011	WIGOS-PO

CONTENTS

WIGOS IMPLEMENTATION PLAN (WIP) [1]

EXECUTIVE SUMMARY

An integrated global observing system, supported by the WMO Information System (WIS) is essential to realizing the socio-economic benefits to be derived from a wide range of weather, climate, water and related environmental products and services. The WMO Integrated Global Observing System (WIGOS) will be an essential component of WMO's strategic activities. It will ensure a coordinated WMO contribution to the cosponsored GOOS and GTOS and will be key to the successful implementation of GCOS in support of the UNFCCC, and in the development and implementation of the Global Framework for Climate Services (GFCS). Through WIGOS and WIS, and their support for GOOS, GTOS and GCOS, WMO will make a fundamental contribution to the success of the Global Earth Observation System of Systems (GEOSS).

The WMO Strategic Planning process, approved by the Fifteenth World Meteorological Congress (Geneva, May 2007) guides the Organization in delivering its contributions to desired societal outcomes. Cg-XV also determined that WIGOS and WIS are strategic initiatives of WMO. These will contribute to the high-level Expected Results (ERs), in particular "Enhanced capabilities of Members to access, develop, implement and use integrated and interoperable surface-based and space-based systems for weather, climate and hydrological observations, as well as related environmental observations, based on world standards set by WMO and partner organizations".

The Sixteenth World Meteorological Congress 2 (Cg-XVI, Geneva, May 2011) expressed …

Cg-XVI decided that …

The objective of this Plan is to describe tasks and activities that WMO Members in collaboration and coordination with their partner organizations will follow to implement WIGOS. These will improve governance, management and integration of the WMO observing systems, and their contributions to co-sponsored systems. The WIP covers the period 2011–2015, incorporating successful aspects of previous plans developed during the WIGOS Test of Concept Phase and addressing needs for the integration.

In implementing WIGOS, it is imperative that the current management, governance and support activities be reviewed and aligned with WMO future priorities. This alignment should enable collaboration and promote cooperation and coordination at the technical, operational and administrative levels.

Achieving the benefits of WIGOS will require commitment from WMO Members, constituent bodies and partner organizations. It was recognized, that progress in WIGOS implementation will be directly related to the level of available resources. To move forward, substantial support to the Secretariat during the next financial period is required for the WIGOS implementation. If the requested resources are not made available, WIGOS implementation will be put at substantial risk.

Given the significance of active cooperation and enhanced coordination among the technical commissions, regional associations and WMO partners, appropriate steps will need to be taken to ensure that the integration process is incorporated in the work programmes and implementation plans of these entities. Both, regional associations and technical commissions will play a fundamental role in this process.

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1 This is a draft WIP developed in accordance with WDIS (ver.1.1; January 2011) and CONOPS (ver.5.1; January 2011); the final WIP will be developed in accordance with decision and guidelines provided by Cg-XVI and EC-LXIII.

2 The text related to Cg-XVI (highlighted in yellow) will be completed in accordance with the decisions of Cg-XVI.

1. WIGOS PROJECT DEFINITION

1.1 Background

The concept of WIGOS, as adopted by the Fifteenth World Meteorological Congress in 2007 (Resolution 30 (Cg-XV), was a strategic initiative of the Organization. This aims to establish a coordinated approach to the management of diverse WMO observing systems resulting in substantial benefits and efficiencies for WMO Members and partner organizations. Cg-XV determined that together with the planning and implementation of the WMO Information System (WIS), the implementation of WIGOS would allow for an integrated WMO end-to-end system designed to improve Members' capabilities to effectively provide a wide range of high quality services and to better respond to all WMO Programmes requirements. The implementation of WIGOS and WIS is a challenge and strong commitments of all involved.

The Sixteenth World Meteorological Congress (Cg-XVI, May 2011) welcomed...

Cg-XVI …

WIGOS development and implementation is directed by the Resolutions 30 (Cg-XV) (WMO-No. 1026), 14 (EC-LXII) (WMO-No. 1059) and 11.3/1 (Cg-XVI).

1.2 WIGOS Vision and Main objectives

The WIGOS Vision calls for an integrated, coordinated and comprehensive observing system to satisfy, in a cost-effective and sustained manner, the evolving observing requirements of WMO Members in delivering their weather, climate, water and related environmental services. WIGOS will enhance the coordination of the WMO observing systems with those of partner organizations for the benefit of society.

WIGOS will provide a framework for enabling the integration and optimized evolution of WMO observing systems, and of WMO's contribution to co-sponsored systems. Together with WIS, this will allow continuous and reliable access to an expanded set of environmental data and products, and associated metadata, resulting in increased knowledge and enhanced services across all WMO activities.

In accordance with a decision of Cg-XVI and the guidance by the WIGOS Development and Implementation Strategy, WIGOS together with WIS, will meet the following objectives:

- Enable WMO Members to better respond to natural hazards, improve weather, water, climate and related environmental monitoring, adapt to climate change and human-induced environmental impacts and meet expanding national mandates while achieving higher national visibility with other environment related agencies;
- Ensure a coordinated WMO contribution to the cosponsored GOOS and GTOS and contribute to the successful implementation of GCOS in support of the UNFCCC, and in the development and implementation of the Global Framework for Climate Services (GFCS);
- Strengthen WMO's contribution to GEOSS;
- Provide a basis for sound decision making and enhance delivery of benefits to society.

An integrated global observing system, supported by WIS, will contribute to realizing the socio-economic benefits from a wide range of weather, climate, water and related environmental products and services based on WMO's core competencies.

1.3 Benefits for Members, Partners, End-users

WIGOS is expected to facilitate timely, quality-assured, quality-controlled and well-documented observations. Improved Quality Management procedures will be required to enable enhanced utilization of both existing and emerging observing capabilities. In meeting the evolving user

requirements, WIGOS will:

- Enable the evolution and integration of WMO observing systems and enhance collaboration with its partner organizations. This will allow access to an expanded set of environmental data and products resulting in increased knowledge and enhanced services (across weather, climate and water domains) in a cost-effective manner;

- Result in enhanced observing capabilities by improving integration between its surface- and space-based components;

- Enable WMO Members to better respond to natural hazards, improve weather, water, climate and related environmental monitoring, and adapt to climate change and other human-induced environmental impacts;

- Enhance operational components of WMO Programmes, especially in Developing and Least Developed Countries and ensure essential WMO support for the observations and information components of GFCS and other WMO future priorities;

- Provide a basis for sound decision making and enhance delivery of services to society in all WMO applications areas;

- Contribute strongly to GOOS, GTOS, GCOS and GEOSS.

1.4 Purpose and Scope of this Plan

In meeting its objectives, WIGOS will not only serve WMO Members and partner organizations but will also make a major and unique contribution to United Nations agencies that are focused on environmental stewardship, and along with WIS, will be a core contribution of WMO to the GFCS as well as to GEOSS.

To achieve its objectives, the scope of WIGOS implementation should encompass the following:

- *Requirements:* Provide a mechanism to meet evolving observing requirements of WMO Members and WMO partner organizations building on the existing Rolling Review of Requirements (RRR) process;

- *Integration and interoperability:* Build upon and add value to the existing WMO observing components of Global Observing System (GOS), Global Atmosphere Watch (GAW), and World Hydrological Cycle Observing System (WHYCOS) with emphasis on integration of surface- and space-based observations;

- *Standardization:* Enhance observational data and products quality and homogeneity by introducing improved data quality and data management standards to better satisfy user requirements;

- *Access:* Improve access to, and utilization of, observations and products from WMO observing systems as well as those of co-sponsored systems.

- *Coordination:* Foster research and development activities and coherent planning for future observing systems and network optimization by working with all WMO Programmes and partner organizations.

The objective of this Plan is to describe tasks and activities that WMO, in collaboration and coordination with partner organizations, will follow to implement WIGOS. These will improve governance, management and integration of the WMO observing systems, and their contributions to co-sponsored systems. The WIP covers the period 2011–2015, incorporating successful aspects of previous plans implemented during the WIGOS Test of Concept Phase and addressing needs for the integration.

2. DELIVERABLES

2.1 Key WIGOS implementation component

This section should introduce the key WIGOS deliverables of the Implementation (IP) and/or the Operational (OP) phases, major activities and allocation of responsibilities. For ease of reference they could be presented in a table form as given below [1].

2.2 WMO Major Activities and Responsibilities

Key implementation components	Phase of completion	Activities	Responsibility	Comments
1. Governance	IP	1.1Develop Regional WIGOS Implementation Plans	*RAs*	Implementation & coordination meetings (ICM)on WIGOS will be held regularly for each Region
	IP	1.2 Facilitate active involvement of Members in regional WIGOS implementation activities	*RAs*	Will be discussed at regional ICM on WIGOS
	IP/OP	1.3 Provide technical guidance and assistance on WIGOS implementation	*TCs*	
	IP	1.4 Establish WIGOS PO	*Secretariat*	
	IP	1.5 In close collaboration with all WMO's constituent bodies and taking into account all WMO's priorities develop proposals for new/adjusted structures of: 1.5.1 WMO Programmes (WIGOS supporting programmatic structure), 1.5.2 WMO Technical Commissions (WIGOS supporting governance structure), 1.5.3 WIGOS Concept of Operations (CONOPS) with special emphasis on WIGOS functional architecture 1.5.4 WMO Technical Regulations (WIGOS supporting procedural structure)	*Secretariat* *Secretariat* *Secretariat & ICG-WIGOS*	
	IP/OP	Update WMO Regulatory Material relevant to observation, including development of the Manual on WIGOS	*TCs*	
	IP	1.6 Provide necessary secretariat support to Members, RAs and TCs, and take appropriate activities for the implementation of WIGOS	*Secretariat*	
2. Data delivery and information services through	IP	2.1 Develop a strategy for the production, editing and management of WIGOS metadata	*ICG-WIGOS TCs*	

[1] *Text in Italic here and elsewhere in the document is a recommendation. The content of the section will have to be drafted at the later stage, in accordance with recommendations by EC-WG/WIGOS-WIS-4 as well as guidance by Cg-XVI and EC-LXIII.*

WIS	IP	2.2 Develop a strategy for the production, editing and management of metadata, for instrumentation/platform, incl. station history	*ICG-WIGOS TCs*	
3. Quality Management, including monitoring, and Standardization	IP/OP	3.1 Provide assistance to Members with specific implementation needs and promote sharing experiences and collaboration of Members in all WIGOS standardization areas	*Secretariat TCs & RAs*	
	IP	3.2 Develop strategy for the standardization process (to guarantee systems interoperability, including development of documented standards for data quality of observing systems and instruments)	*ICG-WIGOS TCs*	
	IP/OP	3.3 Develop suitable quality-control and monitoring tools for observations	*TCs*	
	IP/OP	3.4 Provide quality and data/metadata management related technical guidance, advice and assistance	*TCs*	
4. Planning, optimization of observing systems	IP	4.1 Develop strategy to satisfy observing requirements of WMO Programmes, international partner organizations and related programmes	*ICG-WIGOS Secretariat*	
	IP/OP	4.2 Review observing system performance on a regional basis	*TCs, RAs & Secretariat*	Will be discussed at regional ICMs on WIGOS
	IP	4.3 Implement the RRR process in all application areas	*TCs & RAs*	Will be discussed at regional ICMs on WIGOS
5. Capacity Building	IP/OP	5.1 Identify needs and priorities for WIGOS capacity building	*RAs*	Will be discussed at regional ICMs on WIGOS
	IP/OP	5.2 Coordinate existing and promote proposed regional projects and observation-related initiatives aimed at building capacity within WIGOS	*RAs & TCs*	Will be discussed at regional ICMs on WIGOS
	IP/OP	5.3 Develop WIGOS related guidelines and training materials and other relevant documentation	*TCs*	
	IP	5.4 Develop capacity building partnership with partners and co-sponsors	*Secretariat*	
6. Communications and Outreach	IP	6.1 Develop communication and outreach strategy in collaboration with partners and co-sponsors	*Secretariat*	
	IP/OP	6.2 Develop and manage a WIGOS portal	*ICG-WIGOS Secretariat*	

Table 1: WIGOS activities and responsibilities

3. GOVERNANCE [1]

3.1 General requirements

[1] Roles / Responsibilities of EC, RAs, TCs, Members will be adjusted in accordance with decision of Cg-XVI.

The successful implementation requires clear governance arrangements for all activities to be accomplished. In this regard, it should be mentioned that WIGOS implementation will be based on a common standardization approach, uniform implementation of WMO regulations, system interoperability and data compatibility standards across all WMO observing systems as specified by CONOPS and WDIS. Arrangements should also be made to provide a single focus for integrated and coordinated operational management of all WMO observing systems and a mechanism for coordination with WMO co-sponsored and contributing observing systems.

Therefore, in implementing WIGOS it is imperative that the current management, governance and support activities be reviewed and aligned with WMO strategic planning and results-based management. This alignment should enable collaboration and promote cooperation and coordination at the technical, operational and administrative levels.

3.2 The role of EC

The WMO Executive Council will continue to monitor, guide, evaluate and support the implementation of WIGOS.

3.3 The role of RAs

Regional associations will play essential role in the WIGOS implementation. Regional associations through their WIGOS regional task teams will coordinate planning and implementation of WIGOS on the regional level taking into account all WMO future priorities, such as GFCS and DDR. The regional task teams, in consultation with the Inter-Commission Coordination Group on WIGOS (ICG-WIGOS), should also address regional aspects of standardization, observing system interoperability, data compatibility, data management, Quality Management System (QMS) procedures, performance monitoring, WMO regulatory material issues, and proposed improvements in observing networks/systems.

3.4 The role of TCs and ICG-WIGOS

In accordance with the Resolution 14 (EC-LXII), ICG-WIGOS should be established by EC-LXIII with the Terms of Reference as listed in the Annex to Resolution 14 (EC-LXII). Given the significance of active cooperation and enhanced coordination among the technical commissions, regional associations, and WMO partner organizations, the ICG-WIGOS will ensure that the evolving integration process is incorporated in the work programmes and implementation plans of these entities.

3.5 The role of WMO Members

Cg-XV stressed the important role of Members in the implementation of WIGOS. It also emphasized that the integration should be undertaken to accommodate the diversity among Members with respect to their capabilities and needs. Therefore, depending on levels of development of NMHSs, Members should collaborate actively in, and give all possible support to the following:

- Evolve their observing systems to become their national component of WIGOS,
- Provide adequate resources to the WMO Secretariat to support WIGOS implementation,
- Support regional and global WIGOS implementation activities,
- Keep the Secretary General informed about their WIGOS implementation activities,
- Share relevant experience and cooperate with one another in implementing WIGOS, including assistance to Members with specific WIGOS-implementation needs.

3.6 The role of Secretariat

Coordination through the WMO Secretariat and specifically its WIGOS project office is essential for successful WIGOS implementation. The Secretariat, under the institutional guidance of the WMO constituent bodies, will be in continual contact with Members, working bodies of regional associations

and technical commissions, and relevant international organizations and programmes. The Secretariat in particular, will:

- Establish a WIGOS Project Office;
- Ensure management of, and support to, the WIGOS implementation process;
- Develop proposals for programmatic and governance structures in support of WIGOS taking into account WMO's strategic directions;
- Support WIGOS and WIS implementation;
- Ensure proper coordination with other observing systems contributing to the GFCS as it develops;
- Coordinate and collaborate with partner organizations and programmes in WIGOS activities;
- Support regional associations and technical commissions in developing their WIGOS implementation strategies and projects, including outreach and capacity-building activities;
- Work with Members and donors to provide adequate resources for WIGOS implementation.

3.7 The role of Partner Organizations

Improving coordination will be an ongoing activity at the policy, technical, and Secretariat levels. This will need to be supported by a high-level reconciliation mechanism defined in the WMO-UNESCO-IOC-UNEP-FAO-ICSU Memoranda of Understanding (MOU) in order to resolve possible problems in data policy, product delivery, and other governance issues. These interagency and inter-observing system coordination mechanisms will need to be complemented and supported through similar cooperation and coordination arrangements among NMHSs and through national implementation mechanisms for GCOS, GOOS, GTOS, and GEOSS.

4. PROJECT IMPLEMENTATION SCHEDULE

4.1 Project Phases

In accordance with the guidelines given by Congress, development and implementation of the WIGOS concept proceeded in the phases defined by the annual sessions of the Executive Council.

4.1.1 WIGOS Test of Concept (2007 - 2011)

Cg-XVI recognized that planning and implementation of the Test of Concept Phase (2007-2011) has been accomplished successfully, providing unique lessons learned and experiences gained in the implementation of WIGOS Pilot and Demonstration Projects initiated by technical commissions Members and regional associations, respectively. The Test of Concept Phase also provided grounds for the development of the WIGOS guidance material became available to all Members and partner organizations.

4.1.2 WIGOS Implementation (2012 - 2015)

The Implementation, to be undertaken between 2012 and 2015, will focus on developing and implementing a framework for improved governance, management, integration and optimization of the multiple observing systems coordinated by WMO and its partner organizations. The current WIGOS Implementation Plan defines the essential steps to be undertaken over this period.

4.1.3 WIGOS Operational (2016 onward)

From 2016 onwards WIGOS observing components will continue to evolve to improve service delivery

and support decision making in response to the evolving needs of users and technological opportunities. Although not limited in time, it is anticipated to include an initial period of rapid enhancement of observing capabilities between 2016 and 2019 in order to meet the highest priority needs.

4.2 Key Tasks, Activities and Milestones

Figure 1 shows the key milestones, including routine WIGOS related reports to EC and Congress, and timelines. Some tasks such as coordination with WIGOS component systems will be essential activities throughout and beyond the Implementation phase. The WIGOS project documentation will be a key deliverable early in the period, while Regulatory Documentation will be the focus in later phases. Capacity building will focus on the development of guidelines, training material and providing the technical and infrastructure assistance later in the project. Pilot and demonstration projects will continue to be an important activity in the later implementation stages, especially to assist developing countries including LDCs and SIDS to fully benefit from WIGOS.

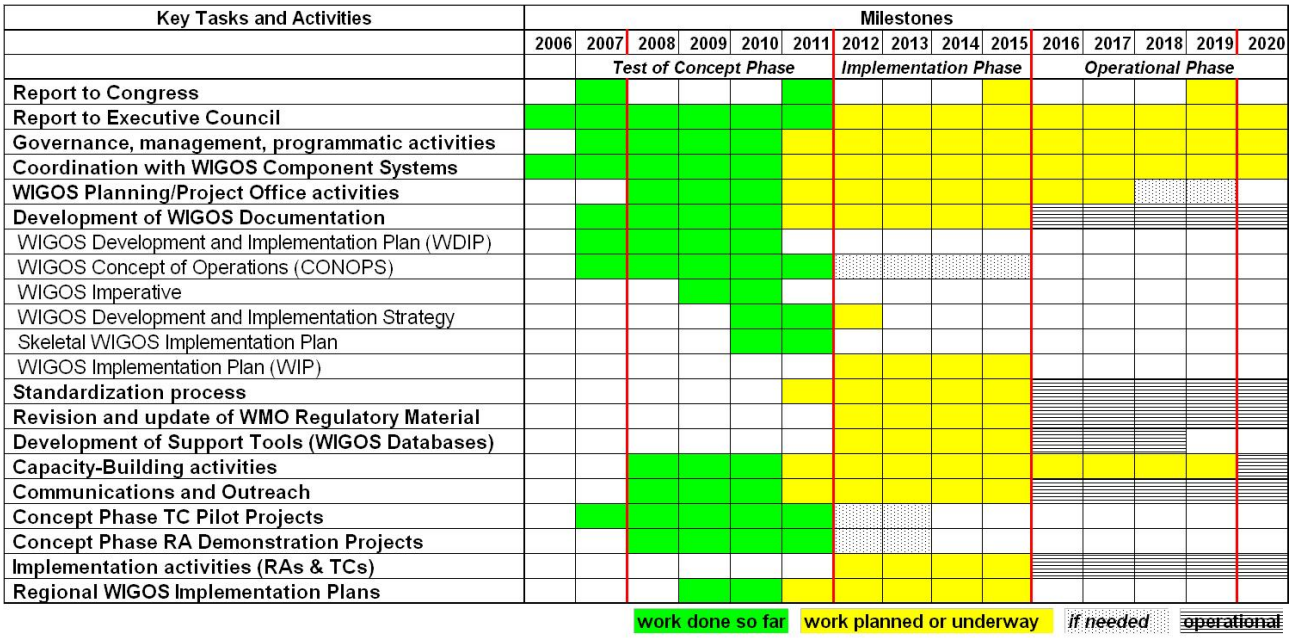

Figure 1: Key Tasks, Activities and Milestones

4.3 Tasks and Actions for WIGOS observing components

WIP should contain a list of tasks for all WIGOS observing components relevant to WIGOS key deliverables and milestones as specified by Sections 2.1 and 4.2. Priority of implementation tasks must be specified (i.e. criteria used to assign priority must be defined, taking into account WMO priorities and resources available).

Integration process should comprise a series of actions to be taken within the frame of individual observing system to ensure successful implementation of WIGOS. Based on positive experience gained by GCOS, the criteria were introduced to assign priorities to the implementation actions. Criteria for placing items within the current or near-future implementation time-line of this Plan include:

- Clearly significant and citable benefits towards meeting the requirements stemming from Resolution 30 (Cg-XV) and Resolution 11.4/X (Cg-XVI) for enhancing integration between the WMO observing systems to improve Members capabilities to effectively provide the widening range of services and to better serve research programme requirements;
- Feasibility of an observation – determined by the current availability of an observation or by knowledge of how to make an observation with acceptable accuracy and resolution in both space and time;

- Ability to specify a tractable set of implementing actions ("Tractable" implies that the nature of the action can be clearly articulated, that the technology and systems exist to take the action, and that an Agent for Implementation, best positioned to either take the action or to ensure that it is taken, can be specified);
- Cost effectiveness – the proposed action is economically justified.

The table reproduced in the Appendix 1 provides an initial draft of areas where specific activities and actions should be accomplished within WMO and co-sponsored observing systems to support implementation of WIGOS[1] in achieving corresponding deliverables. Existing Implementation/Strategic plans of WIGOS observing components will be taken into account when the WIP is further elaborated.

5. PROJECT MANAGEMENT

5.1 Project Framework

The WIGOS project framework consists of two parts. The first part is the organizational framework set up by the WMO Executive Council in order to monitor, guide and support the implementation of WIGOS in accordance with Congress decisions. The second part is the administrative structure within the WMO Secretariat.

Organizational Framework

For the WIGOS Test of Concept Phase (2007-2011), the organizational structure of the WIGOS project was set up by Resolution 3 (EC-LIX) in 2007 establishing an Executive Council Working Group on WIGOS and WIS (EC-WG/WIGOS-WIS) to steer and monitor WIGOS development and implementation activities and coordinate institutional arrangements for planning and overseeing WIGOS and WIS. The EC-WG/WIGOS-WIS established a Subgroup on WIGOS (SG-WIGOS) to provide overall technical guidance, assistance and support for the implementation of the WIGOS.

During the WIGOS Implementation Phase, it is highly desirable that an Inter-Commission Coordination Group on WIGOS (ICG-WIGOS) be established. This group would replace the Subgroup on WIGOS and under the guidance of the EC it would be expected to:

- Coordinate, review, refine, and assess the development and implementation of WIGOS;
- Provide technical guidance and assistance for the WIGOS development, planning, and implementation activities, such as standardization and development of WIGOS databases;
- Advise regional associations on WIGOS implementation activities;
- Advise technical commissions on the standardization process and related activities;

Secretariat Structure

The Secretariat provides support to ICG-WIGOS. The WIGOS development and implementation has been coordinated by the WIGOS planning office that was established but is yet to be fully staffed. Taking into account the role, responsibilities and scope of the work required, establishing a fully staffed WIGOS Project Office will be essential for accomplishing the requested tasks.

5.2 Project monitoring and review

The project monitoring should be undertaken by the WIGOS Project Office. A regular reporting system will be developed to provide information on progress at the end of each year towards achieving results. Gaps will be identified, analyzed and corrective actions initiated, if needed.

5.3 Evaluation Methodology

1 Implementation activities will be accomplished in close coordination with WMO Partners

The evaluation methodology should be designed with respect to the objectives and performance measures. It should include a schedule of monitoring and evaluation activities and related responsibilities. Where formal evaluation is taken, conflict of interest should be avoided. Mid-term evaluation, interim progress reports and post-implementation reviews should be considered as a means of providing early feedback on progress towards success, and as a means of meeting accountability and transparency requirements.

The methodology will be to compare numbers of activities committed to in the budget with the numbers achieved. Appropriate measures of success in the activities will include counting the numbers of activities completed, while the effectiveness of these activities for Members, user-institutions and partnering agencies will be assessed through surveys of participants at meetings and various training events, and of users of the publications, and through field missions to NMHSs for ground truth assessment of impacts, in particular for those outcomes linked to capacity-building. Such field missions would be carried out in collaboration with the WMO Secretariat DRA Department and the WMO regional offices.

5.4 Implementation/success indicators

The development of performance indicators to measure progress, both quantitative and qualitative, should be taken. Performance indicators should be developed for each activity as well as for the whole implementation phase. NMHSs should provide baseline information as requested. Performance indicators provide a basis for the Project evaluation activities.

In order to evaluate the WIGOS implementation, minimum Critical Success Indicators (CSI) should be defined for the individual steps of the integration process:

1) Implementation of the WIGOS organizational framework;

2) Integration of WMO systems (*achievable targets to be identified by the Congress)*:

2.1 Integration of the surface-based observing systems,

2.2 Integration of the space-based observing systems to more thoroughly address climate and other related terrestrial observations,

2.3 Integration of the space- and surface-based components of the GOS;

2.4 Integration of all WMO observing system components;

3) Integration process fully reflected in WMO Technical Regulations (upon the development and endorsement of the Manual on WIGOS by Cg-XVII);

5) Manual on WIGOS accepted by partner organizations.

5.5 Capacity-building

An effective capacity-building and training strategy is an essential component of the WIGOS. A coordinated capacity-building effort should assist developing and least developed countries to improve and sustain their contributions to WIGOS observing systems, including access to and effective utilization of observations, data and products, and related technologies. As a key factor in successful WIGOS implementation, capacity building activities at national and regional levels will be focused on:

- Institutional mandates and policies;
- Infrastructure establishment and/or strengthening;
- Human skills development and training;
- Technical assistance; and
- Technology transfer.

To take advantage of WIGOS benefits and to ensure that information and services are used to the maximum extent possible, transfer of technological innovations and development of decision support tools will be essential. For this purpose, specialized education and training activities should be reflected in the Regional WIGOS implementation plans, especially for NMHSs of Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

5.6 Communication and Outreach

Development and implementation of relevant communications and outreach activities will be one of the key prerequisites to the success of WIGOS. These activities will comprise the following core areas:

- Interaction of the WIGOS Project Office with the secretariats of WMO-co-sponsored observing systems and user programmes. The Project Office should also coordinate WIGOS activities with those related to WMO future priorities, as well as related activities of GCOS,GOOS, GTOS and GEOSS;

- Active involvement of regional associations and technical commissions through. Regional/inter-commission expert teams that will participate in the development and implementation of WIGOS at the regional/ technical commission levels;

- Establishment and management of a WIGOS portal. This portal will provide relevant information to stakeholders on WIGOS development, implementation, and standardization processes and on the communications and outreach strategy, and

- Proactive identification of new users as WIGOS evolves.

6. RESOURCES

6.1 Funding of WIGOS

Most of resources needed for WIGOS implementation will be provided through existing WMO and national mechanisms, including voluntary contributions to special projects. It should be underlined that the timely completion of the WIGOS implementation in the sixteenth financial period 2012-2015 critically depends on adequate resources (budget and expertise).

The investment for fully implementing WIGOS should be given a high priority in Members' development and implementation plans. In addition, extra resources will need to be provided to the WMO Secretariat for both staff and non-staff costs for the implementation and coordination that are beyond the normal programmatic activities of the Secretariat. As a result, additional budgetary resources need to be allocated to the WIGOS implementation phase. To ensure the funding needed for WIGOS implementation, the following resources should be considered:

- WMO Regular Budget for WIGOS implementation support activities;

- WIGOS Trust Funds to supplement WMO Regular Budget;

- In kind contributions;

- Staff secondments;

- Voluntary Cooperation Programme funds for WIGOS related technical cooperation and capacity-building activities;

- Regional fundraising activities to support WIGOS.

6.2 Cost definitions

6.2.1 Estimated total annual WIGOS implementation costs

This section should include the allocation of estimated funds against key project deliverables. In particular, costs for implementing Actions of this Plan should be estimated as additional annual costs on the top of the costs of existing observing networks, systems and activities that are required to implement integration process. An approach used in the IP for the GCOS in Support of the UNFCCC

(2010 update) may be applied.

6.2.2 WIGOS Secretariat activities

The WIGOS Project Office needs to be established within the Secretariat. It must be adequately staffed and resourced to meet the role, responsibilities and scope of the project. This will ensure a suitable project management function, improved coordination and cooperation with technical commissions, regional associations and partner organizations, capacity-building as well as communications and outreach activities that are essential for WIGOS implementation.

In response to the request for a WIGOS comprehensive costed development and implementation strategy, the Secretariat has provided the detailed cost/resources estimation needed (see Appendix 2, Tables 1 and 2).

6.2.3 Link to Deliverables and Risk Management Plan

The section should contain explanation and guidance on how estimated expenditures are related to all actions proposed in this Plan.

6.3 Fund rising activities

This section should specify activities to secure funds and resources needed for the implementation of WIGOS on national and international levels.

7. RISK ASSESMENT/ MANAGEMENT

7.1 Risk identification and periodical revisions

An initial risk assessment (see WDIS, section 4.2) identifies the implementation of WIGOS as a high risk project because of its *Complexity, Basic infrastructure and Resources*. Therefore, risks will need to be clearly identified and managed at various points throughout the project, including the development of associated mitigation and contingency plans. The Secretariat will take a coordinating role in overall risk management by providing a focal point for these activities.

This section should contain Risk Management Plans (RMP) within the frame of each participating observing system (or make reference to the RMP, if it exists).

7.2 Risk mitigation activities

This section should specify Risk mitigation activities within the frame of each participating observing system (or make reference to the RMP, if it exists).

Annex to Resolution 14 (EC-LXII)

TERMS OF REFERENCE FOR INTER-COMMISSION COORDINATION GROUP ON WIGOS (ICG-WIGOS)

- To coordinate and evaluate WIGOS related activities carried out by relevant technical commissions;

- To provide technical guidance and assistance for the planning, implementation and further development of GOS, GAW and WHYCOS as core components of WIGOS, including standardization of instruments and methods of observation, WIS information exchange and discovery and Quality Management Framework;

- To advise the regional associations on the technical aspects of WIGOS implementation activities in the respective Regions;

- To maintain close cooperation at a technical level with WMO's partner organizations such as UNESCO and its IOC, UNEP, FAO, and ICSU and co-sponsored observing systems GCOS, GOOS and GTOS;

- To address major issues identified by the EC Working Group on WIGOS and WIS and provide technical advice on the further development and implementation of WIGOS;

- Report to the EC Working Group on WIGOS and WIS.

Appendix 1 – List of activities within WMO and co-sponsored observing systems to support implementation of WIGOS 1

Key implementation components	Observing System						
	GOS[2]		***GAW***	***WHYCOS***	***GCOS***	***GOOS***	***GTOS***
	Surface	*Space*					
1. Governance			Membership in WG WIGOS-WIS and its subgroup	WHYCOS International Advisory Working Group (WIAG). Membership in WG WIGOS-WIS and its subgroup	Membership in ICG-WIGOS		
2. Data delivery and information services through WIS			GAWSIS metadata pilot project for WIGOS Several WDCs in GAW will become WIS DCPCs	Global Runoff Data Centre (GRDC) for global hydrological data. Hydrological Information Systems through regional entities	Rely on data delivery done in contributing networks		
3. Quality Management, including monitoring and Standardization			See Table 1 "Central Facilities" p. 18 in GAW SP (GAW Report 172)	Publication of guidelines and manuals in Hydrology	Rely on contributing networks' quality management Guideline for the generation of data sets and products meeting GCOS requirements (GCOS no. 143) Rely on contributing networks' quality management Guiding principles have been set up Guideline for the generation of data sets and products meeting GCOS requirements (GCOS no. 143)		
4. Planning and optimization of observing systems			GAW global and regional networks support many purposes, the implementation of the IGACO strategy by GAW. GAW complies with GCOS strategy.	In accordance with WHYCOS guidelines and regional priorities	GCOS Implementation Plan (GCOS No. 138). Close collaboration with space agencies through CEOS and CGMS.		
5. Capacity Building			For all regions: GAWTEC Instrument intercomparisons Dedicated workshops	Production of SOPs, Training courses for the operating staff of WHYCOS projects	GCOS Regional Workshop Programme, resulting in ten regional action plans Programmatic guidance to "Climate for Development in		

1 The initial draft

2 It is recognized that other systems use satellite data and products

					Africa" Programme. GCOS Cooperation Mechanism and System Improvement Programme		
6. Communications and Outreach			Antarctic ozone bulletins, GHG bulletin, assessment contributions	Through the WhyCOS web page Regional outreach through regional implementation partners, i.e. river basin organisations	GCOS Newsletter Various brochures Web site National GCOS coordinator and focal points		
7. WIGOS Regulatory material			GAW Technical manuals contribute to WIGOS regulations.	WHYCOS SOPs Data reporting increasingly compliant with WIS.	See no. 3, 4 and 5 under line 3, above		

Appendix 2 – Secretariat cost/resources estimation

Secretariat cost/resources estimation

Table 1: WIGOS Secretariat activities and funds needed for 2012-2015 (CHF)

No	*Activities* [1)]	*Required funds*
1	Governance, management, programmatic activities	500,000
2	Coordination with WIGOS Component Systems	100,000
3	Development of the WIGOS Implementation Plan	10,000
4	Standardization process	100,000
5	Develop, revise and update of WMO Regulatory Material (Manuals, Guides)	100,000
6	Development of WIGOS Databases	
	Operational DB	200,000
	Standardization DB	200,000
	User Requirements and Operational Capabilities DB	200,000
7	Capacity Building	200,000
8	Communications and Outreach	50,000
9	Translation and publication costs	20,000
	TOTAL:	**1,680,000**

[1)] ***Breakdown for each activity is given below*** (these costs are fully related to integration activities with respect to the WIGOS Implementation Phase)***:***

1. Resources amounting to CHF 500K cover: four meetings of the EC body1 (4x40K=160K); four meetings of the ICG-WIGOS (4x25K=100K); six regional WIGOS implementation-coordination meetings (6x40K=240K);
2. CHF 100K is allocated to convene two WIGOS coordination meetings of experts representing GOS, GAW, WHYCOS, GCOS, GOOS, GTOS (2x50K=100K);
3. CHF 10K is allocated for consultant services to assist the Secretariat in the preparation of the WIP;
4. CHF 100K covers expert services to assist countries to carry out Site classification (50K) and Maintenance classification (50K) for each WMO region;
5. CHF 100K covers consultant services to develop WIGOS-related amendments to the Manual on the GOS (10K), Guide on the GOS (10K), CIMO Guide (20K), WHYCOS Guidelines (10K), Guide to Marine Meteorological services (10K), GAW Guide (10K) and to develop the Manual on WIGOS (30K) (this does not include translation and publication costs);
6. Resources of CHF 200K for each of three WIGOS DBs cover: two expert meetings (2x25K=50K); development of the DB' technical specifications (40K); development of software (50K); development of the Operations Manual (10K); implementation of DBs, including data transfer and input (50K);
7. CHF 200K is allocated to convene one WIGOS training workshop in each WMO Region (6x30K=180K) and accomplish four expert fact-finding missions (4x5K=20K);
8. CHF 50K covers the development of the WIGOS Portal (10K); representation of WIGOS PO at the regional/inter-commission expert team meetings (20K) and at the relevant coordination meetings of partner' organizations (20K).

1 Cg-XVI / EC-LXIII will take a decision on it

Table 2: WIGOS Project Office staff resources needed for a period 2012-2015

No	*Position*	*Activities [2]/Duties*	*Staff cost for 2012-2015 (CHF)*
1	WIGOS Project Manager [3]	1-8: To lead the WIGOS Project Office taking into consideration lessons learned from existing and future WIGOS projects. This person would also manage and review the implementation of WIGOS, undertake the necessary liaison within the Secretariat and stakeholders and to oversee all the projects within WIGOS.	900,000
2	WIGOS Support and Capacity building Manager	8: To accomplish general duties, such as outreach activities and capacity building. In particular, to assist with capacity building in Member countries and to work with Education and Training (ETR) and Development Cooperation and Regional Activities (DCR) to ensure Members, especially in least developed countries, reap the full benefits of WIGOS. An important role of this position will be to maintain the project register on activities in collaboration with other observing system staffs and task leaders including those not resident in the WMO Secretariat.	500,000
3	WIGOS Technical Documentation Manager	5: To review existing Technical Documentation and Regulations for observing systems in order to prepare appropriate updates as well as the Manual on WIGOS and related guidelines, and to support the expert teams in production of other guidance material such as those needed on the preparation and maintenance of metadata. This officer will also play a key role in the review of technical regulations in coordination with WIS.	500,000
		TOTAL:	**1,9 million**

[2] Activities in accordance with Table 1

[3] The WIGOS Project Manager post is established and financed from the WMO regular budget

REFERENCED DOCUMENTS

Reports of WMO Constituent bodies

1. Fifteenth World Meteorological Congress, Abridged final report with resolutions (WMO-No. 1026)
2. Sixteenth World Meteorological Congress, Abridged final report with resolutions (WMO-No. XXXX)
3. EC-LVIII, Abridged final report with resolutions (WMO-No. 1007)
4. EC-LIX, Abridged final report with resolutions (WMO-No. 1027)
5. EC-LX, Abridged final report with resolutions (WMO-No. 1032)
6. EC-LXI, Abridged final report with resolutions (WMO-No. 1042)
7. EC-LXII, Abridged final report with resolutions (WMO-No. 1059)
8. CBS-XIV, Abridged final report with resolutions and recommendations (WMO-No. 1040)
9. CBS-Ext.(2010), Abridged final report with resolutions and recommendations (WMO-No. XXXX)
10. Final report of the 1st session of the EC WG on WIGOS-WIS (December, 2007)
11. Final report of the 2nd session of the EC WG on WIGOS-WIS (May, 2009)
12. Final report of the 3rd session of the EC WG on WIGOS-WIS (March, 2010)
13. Final report of the 4th session of the EC WG on WIGOS-WIS (February, 2011)
14. Final report of the 1st session of the Subgroup on WIGOS of the EC WG on WIGOS-WIS (November, 2008)
15. Final report of the 2nd session of the Subgroup on WIGOS of the EC WG on WIGOS-WIS (October, 2009)
16. Final report of the 3rd session of the Subgroup on WIGOS of the EC WG on WIGOS-WIS (October, 2010)

Other relevant documentation

17. Vision for the GOS in 2025 (CBS-XIV, 2009)
18. WIS Project and Implementation Plan (v. 1.2, February, 2010)
19. Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (GCOS-138, WMO/TD-No. 1523)
20. WMO Global Atmosphere Watch (GAW) Strategic Plan: 2008-2015 (WMO/TD No. 1384)
21. Implementation Plan for Evolution of Space-and Surface-based Subsystems of the Global Observing system (WMO/TD-No. 1267)
22. WCRP Implementation Plan 2010-2015 (WMO/TD-No. 1503
23. The first U.S. Integrated Ocean Observing System (IOOS) Development Plan, Washington, DC, January 2006
24. Global Earth Observation System of Systems GEOSS 10-Year Implementation Plan (GEO 1000, February 2005)
25. EUCOS programme management documentation
26. THORPEX International Research Implementation Plan (WMO/TD-No.1258)
27. JCOMM Observing System Implementation Goals for Building a Sustained Global Ocean Observing System in Support of the Global Earth Observation System of Systems (2009)
28. Overarching Implementation Plan for the Ocean Data Portal and WIGOS Pilot Projects for IODE and JCOMM (6 November 2008)

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DEFINITIONS

The section will be developed in due course.

LIST OF ACRONYMS

CBS	WMO Commission for Basic systems
CONOPS	Concept of Operations
CIMO	WMO Commission for Instruments and Methods of Observations
EUCOS	EUMETNET Composite Observing System
EC-WG/WIGOS-WIS	Executive Council Working Group on WIGOS and WIS
FAO	Food and Agriculture Organization
GAW	Global Atmospheric Watch
GCOS	Global Climate Observing System
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GFCS	Global Framework for Climate Services
GOOS	Global Ocean Observing System
GOS	Global Observing System
GTOS	Global Terrestrial Observing System
ICSU	International Council for Science
IOC	Intergovernmental Oceanographic Commission
JCOMM	WMO/IOC Joint Commission for Marine Meteorology
LDCs	Least Developed Countries
MOU	Memorandum of Understanding
NMHS	National Meteorological and Hydrological Service
QMS	Quality Management System
RA	Regional Association
RRR	Rolling Review of Requirements
SG-WIGOS	Sub-group on WIGOS
SIDS	Small Island Developing States
TC	Technical Commission
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WDIP	WIGOS Development and Implementation Plan
WDIS	WIGOS Development and Implementation Strategy
WHYCOS	World Hydrological Cycle Observing System
WIGOS	WMO Integrated Global Observing System
WIP	WIGOS Implementation Plan
WIS	WMO Information System

Appendix VII

Draft Resolution 11.3/1 (Cg-XVI)

IMPLEMENTATION OF THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

THE CONGRESS,

Noting:

(1) Article 2 of the Convention of the World Meteorological Organization,

(2) Resolution 30 (Cg-XV) – Towards enhanced integration between WMO observing systems,

(3) Resolution 14 (EC-LXII) – Implementation of the WMO Integrated Global Observing System (WIGOS),

(4) WMO Strategic Plan,

Considering:

(1) The greater vulnerability of society to extreme weather events and climate change and the need for more extensive and advanced information for WMO Members so that they can continue to improve service quality and to extend further service delivery,

(2) The benefits that can be realized through a more coordinated, collaborative and cost-effective approach to the planning and operation of an integrated global observing system,

(3) With satisfaction the progress achieved in the planning for the implementation of WIGOS (2007-2011),

(4) The importance of WIGOS to the development and implementation of GFCS,

Appreciating:

(1) The important contributions Members, international partner organizations and programmes make towards observing the Planet Earth,

(2) The relevant work undertaken by Members, the Executive Council, the regional associations, the technical commissions, the EC Working Group on the WMO Integrated Global Observing System and the WMO Information System and the Secretary-General on the development and implementation of the WIGOS initiative launched by the Fifteenth Congress,

Recognizing that:

(1) WIGOS and WIS are major priorities of the Organization to improve Members' capabilities to effectively provide in a timely fashion a wide range of high quality data, products and services,

(2) WIGOS will enable the evolution and integration of the observing system components of WMO and enhance collaboration with its partner organizations and programmes,

(3) WIGOS will improve WMO Members' ability to meet expanding national mandates and achieve higher visibility of NMHSs with other environment related agencies,

(4) WIGOS will provide a framework for improved collaboration and coordination between NMHSs and relevant national and regional organizations,

(5) WIGOS will enable WMO Members to better respond to natural hazards, improve environmental monitoring, and adapt to climate change and man-made environmental impacts, especially in Developing and Least Developed Countries,

(6) WIGOS will lead to cost-effectiveness and enhancing observing capabilities of Members,

(7) WIGOS is a necessary prerequisite to allow WMO Members to realize the organization's strategic thrusts,

Decides to implement the WMO Integrated Global Observing System (WIGOS),

Decides further that implementation activities will be undertaken during the next financial period as one of the major effort of the Organization with the goal that WIGOS should become operational from 2016 onwards,

Requests:

(1) The Executive Council to:

(a) Monitor, guide and support the implementation of WIGOS,

(b) Establish an Inter-Commission Coordination Group on WIGOS (ICG-WIGOS),

(2) Regional associations to:

(a) Develop their regional WIGOS implementation plan,

(b) Coordinate WIGOS implementation activities with WIS in their operating plan and work programme,

(c) Promote capacity-building and outreach activities to assist Members in the implementation of WIGOS,

(3) Technical commissions to:

(a) Guide the technical aspects of WIGOS implementation,

(b) Incorporate WIGOS implementation activities in their operating plan and work programme,

(c) Provide technical guidance and advice to Members and the Regional Associations on WIGOS,

(d) Develop guidance for the design and evolution of observing components of WIGOS,

(e) Develop standards to support WIGOS in collaboration with partner organizations and programmes,

(f) Update WMO Regulatory Material, including development of the Manual on WIGOS,

(g) Provide the technical lead for WIGOS through the Commission for Basic Systems (CBS) and the Commission for Instruments and Methods of Observation (CIMO),

(4) Members to:

(a) Evolve their observing systems to become their national component of WIGOS,

(b) Coordinate their WIGOS and WIS implementation activities,

(c) Provide experts to participate in the WIGOS related work of technical commissions,

(d) Provide adequate resources to the WMO Secretariat to support WIGOS implementation,

(e) Support regional and global WIGOS implementation activities,

(f) Keep the Secretary-General informed about their WIGOS implementation activities,

(g) Share relevant experience and cooperate with one another in implementing WIGOS, including assistance to Members with specific WIGOS-implementation needs,

(5) The Secretary-General to:

(a) Ensure management of, and provide adequate resources in support of the WIGOS implementation,

(b) Establish a WIGOS Project Office,

(c) Support the review and update of WMO Regulatory Material, including the development of the Manual on WIGOS,

(d) Coordinate and collaborate WIGOS activities with UN organizations and other relevant international organizations and programmes,

Invites Partner Organizations to collaborate with WMO on the implementation of WIGOS.

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Note: This resolution replaces Resolution 30 (Cg-XV), which is no longer in force.

Annex to paragraph 4.3

WIGOS CONCEPT OF OPERATIONS (CONOPS)

WIGOS Design and Functional Architecture

CONTENTS

Comments:

1) "**INTRODUCTION**" will explain the purpose of this document as an extension of the original CONOPS describing in more details an overall structure of WIGOS operations.
2) Original sections 5.2.1 - 5.2.9, and 7 will be expanded to include:
   - Core WIGOS operational activities illustrated by a functional diagrams that depict the system architecture and its environment;
   - WIGOS organizational, programmatic, governance and procedural structures for standardization process and uniform implementation of WMO regulations and best practices to ensure data integration and interoperability across all WMO observing systems will be specify.
   - Specification of WIGOS core services, associated components, relevant procedures and responsibilities in the activities/operations.
   - Tasks to be undertaken by WMO Members when implementing WIGOS taking into account the WIGOS documentation (incl. Manual on WIGOS and other related guidelines) developed by relevant TCs.

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