PILOT PROJECT FOR THE INTEGRATION OF MARINE METEOROLOGICAL AND OTHER APPROPRIATE OCEANOGRAPHIC OBSERVATIONS INTO THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

(WIGOS Pilot Project V - JCOMM Pilot Project for WIGOS)

PROJECT REPORT

WMO/TD-No. 1515

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WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

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NOTES

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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

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FOREWORD

The Pilot Project for the integration of marine meteorological and other appropriate oceanographic observations into the WMO Integrated Global Observing System (WIGOS), also known as the JCOMM Pilot Project for WIGOS, is an important contribution to the development of WIGOS and the WMO Information System (WIS).

The Pilot Project has been an interdisciplinary exercise, implemented and sustained by WMO and IOC through JCOMM, to investigate the integration of *in-situ* and space based ocean observing systems collected within the oceanographic community. The Pilot Project considered instruments and methods of observation aspects, as well as data management, data exchange, and quality management.

Due to the important synergies that existed with the IODE Ocean Data Portal (ODP) project, a joint Steering Group was established to coordinate the development of the Pilot Project and to provide liaison with appropriate WMO and IOC programmes and subsidiary bodies. The "*Joint Steering Group for the IODE Ocean Data Portal and the JCOMM Pilot Project for WIGOS*" has two co-chairs - one with an IODE ODP and one with a WIGOS – and more specifically instruments and methods of observation – perspective.

The Pilot Project identified three key deliverables: (i) document and integrate instrument best practices and related standards, (ii) build marine data systems that are interoperable with the WIS, and (iii) promote quality management and standards through compliance with the WMO Quality Management Framework (QMF).

Significant achievements have been realized including a review of the WMO and IOC Technical Publications and updating of the marine chapter of the WMO CIMO Guide, development of the IODE ODP to be interoperable with the WIS as a Data Collection or Production Centre (DCPC), establishment of WMO-IOC Regional Marine Instrument Centres (RMIC) with their Terms of Reference approved by JCOMM-III, development of appropriate quality management standards through the IODE/JCOMM Standards process, and the production of a catalogue on JCOMM best practices and standards.

A strategy for updating WMO and IOC Publications in order to harmonize standards was also proposed by the Pilot Project. Key datasets have been identified for which interoperability with the ODP and/or the WIS should be developed, and commitments already made by some of the agencies holding these datasets. USA, China and Morocco have offered to host RMIC facilities in Regional Associations IV, II, and I respectively. Three training courses on the use of the ODP have been organized, as well as one workshop on Marine Instrumentation to test the concept of RMIC at the facilities offered by the USA.

WMO Members and IOC Member States will benefit from the integration of marine meteorological and other appropriate observations into WIGOS in a number of ways including (i) reduced financial demands on Members and Member States through the provision of multi-disciplinary access to data from WIS and ODP permitting cost-savings based on synergies between disciplines; (ii) increased visibility for Members and Member States producing ocean observations and related products and services; and (iii) better research for future applications.

JCOMM, as a joint Technical Commission between WMO and IOC, provided the appropriate governance and mechanisms to engage with all partners and this has been a major factor in the success of the Pilot Project. The IOC, through its IODE Committee, provided excellent cooperation and good working relationships were established between the WMO and IOC secretariats.

A number of legacy recommendations have been proposed based on the Pilot Project achievements and lessons learned. A future workplan is proposed with costing estimated at $95k per year to support the proposed activities, and an additional $10k to recruit a consultant to compile guidelines for marine instrument intercomparisons.

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(Co-Chairpersons, Joint Steering Group for the IODE Ocean Data Portal and the JCOMM Pilot Project for WIGOS)

Pilot Project for the Integration[1] of marine meteorological and other appropriate oceanographic observations into the WMO Integrated Global Observing System (WIGOS)
(WIGOS Pilot Project V - JCOMM Pilot Project for WIGOS)

PROJECT REPORT

1) Introduction

1.1 The WMO Integrated Global Observing System (WIGOS), endorsed by the Fifteenth WMO Congress[2] (Cg-XV) is a major contribution of the World Meteorological Organization (WMO) to address the need for more extensive and advanced information for WMO Members so that they can continue to improve service quality and service delivery. To meet the demands of the future, WMO Members must continue their legacy of contributions by taking full advantage of advances in observation and telecommunication technologies and to increase our science based 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.

1.2 The WMO Fifteenth Congress (Cg-XV, Geneva, Switzerland, 7-25 May 2007) therefore decided that the enhanced integration of the WMO observing system should be pursued as a strategic objective of the WMO and identified this as a major expected result of the WMO strategic plan. WIGOS will establish an integrated, comprehensive and coordinated observing system to satisfy in a cost-effective and sustained manner the evolving observing requirements of WMO Members and will enhance coordination of WMO observing systems with those of partner organizations, such as the Intergovernmental Oceanographic Commission (IOC) of the United National Educational, Scientific and Cultural Organization (UNESCO), for the benefit of society.

1.3 The stated vision of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM[3]) for 2010 to 2012 is to coordinate, and develop and recommend standards and procedures for a fully integrated marine observing, data management and services system that uses state-of-the-art technologies and capabilities; is responsive to the evolving needs of all users of marine data and products; and includes an outreach programme to enhance the national capacity of all maritime countries. The long-term objectives for JCOMM are: (i) to enhance the provision of marine meteorological and oceanographic services; (ii) to coordinate the enhancement and long-term maintenance of an integrated global marine meteorological and oceanographic observing and data management system, within the context of the ICSU[4]-IOC-UNEP[5]-WMO Global Ocean Observing System (GOOS), WIGOS, and the WMO Information System (WIS) and as a contribution to the Global Earth Observing System of Systems (GEOSS); and (iii) to manage the evolution of an effective and efficient programme, embracing all maritime Members/Member States.

1.4 In a way consistent with the JCOMM vision and WMO and the IOC Strategic planning, the JCOMM Pilot Project for WIGOS is an important contribution in the development of WIGOS and

1: Integration is defined in the WIGOS Concept of Operations (CONOPS). Observations collected under the WIGOS framework are not necessarily owned by WIGOS nor WMO since co-sponsoring International Organizations, and their Members/Member States also provide observations and have ownership. WMO is working with partner International Organizations with the goal to harmonize instrument, data exchange, and quality management standards, and achieve interoperability between the different component data systems. Some of the standards promoted under WIGOS do not belong to WMO.

2: Through Resolution 30 (Cg-XV), the WMO fifteenth Congress (Geneva, Switzerland, 7-21 May 2007) has agreed to embark towards enhanced integration between WMO observing systems.

3: http://www.jcomm.info

4: ICSU: International Council for Science, http://www.icsu.org/

5: UNEP: United Nations Environment Programme, http://www.unep.org/

the WIS. Much progress – detailed in this report – has been realized in the course of the Pilot Project in close cooperation between the WMO and IOC.

1.5 This Project report provides rationale for the development of the Pilot Project, summarizes the activities undertaken under the Pilot Project, especially with regard to its three key deliverables, and provides information on its achievements, and lessons learned. In the context of marine meteorological and oceanographic observations relevant to WMO Programmes and Co-sponsored Programmes, this report explains the benefits of WIGOS integration for National Meteorological and Hydrographic Services (NMHSs), National Oceanographic Data Centres (NODCs, of IOC), and also for ocean data users. It provides information on the impact of this integration process on the activities of NMHSs, and NODCs. The report also makes an analysis of strengths and weaknesses in the management of the ocean observing systems, leading to some legacy recommendations for the project legacy in terms of instrument practices, data exchange, quality management, governance, and Capacity Building. Finally, the report provides for a proposed workplan, responsibilities and costing as part of the Pilot Project legacy.

1.6 This report may be used by the Directors of NMHSs or NODCs to make the case at the national level for achieving the described integration, and therefore engaging in the necessary developments, funded nationally, to meet the requirements proposed under the Pilot Project.

2) Goals of the Pilot Project

2.1 The aim of the Pilot Project was to enable and prove concept for the integration into WIGOS of marine meteorological and other appropriate oceanographic observations (*in situ*, surface marine, and satellite data), real time and delayed mode data and products (e.g. models) collected and shared within the meteorological and oceanographic communities. In this exercise, the Pilot Project considered instruments and methods of observation aspects, as well as data management, data exchange, and quality management. It also considered assembled *in situ* fields, biochemistry, model outputs, surface and underwater marine climatologies and measurements. The goals of the Pilot Project were to:

- Develop guidelines for agreeing on consistent instrument and data management standards to be used across the community in accordance with the quality management principles. Traceability to standards was an important aspect considered. Some standards have been proposed and/or updated to prove concept.
- Increase accessibility of data and making appropriate identified datasets interoperable with the wider WMO and IOC communities through the WMO Information System (WIS) and the Ocean Data Portal (ODP) of the International Oceanographic Data and Information Exchange (IODE[6]) of the IOC.
- Set guidelines regarding Capacity Building and training programme regarding this integration effort.

3) Scope and organization of the Pilot Project

3.1 The joint JCOMM/IODE Steering Group

3.1.1 At the *ad hoc* planning meeting for the JCOMM Pilot Project for WIGOS, Ostend, Belgium, 29 March 2008, the requirements for establishing a Steering Group for the WIGOS Pilot Project, including its Terms of Reference and membership were discussed. The meeting recalled the recommendation from the Third Session of the JCOMM Data Management Coordination Group (DMCG), Ostend, Belgium, 26-28 March 2008, to combine efforts of the JCOMM Pilot Project for WIGOS with the Ocean Data Portal initiative of the IODE as important synergies were foreseen between the two projects. It was proposed to establish a joint Steering Group instead of two

6: http://iode.org

distinct steering teams to coordinate the development of the JCOMM Pilot Project for WIGOS and the IODE Ocean Data Portal, providing liaison with appropriate WMO and IOC Programmes and subsidiary bodies.

3.1.2 The Steering Group was called the "Joint Steering Group for the IODE Ocean Data Portal and the JCOMM Pilot Project for WIGOS". The *ad hoc* planning meeting proposed that the Steering Group should have two co-chairpersons, one with an IODE ODP perspective (Mr Greg Reed, Australia), and one with a WIGOS – and more specifically instruments and methods of observation – perspective (initially Mr Rainer Dombrosky, USA, and later Dr Jitze van der Meulen, the Netherlands). The Terms of Reference and membership of the joint Steering Group for the IODE Ocean Data Portal and the JCOMM Pilot Project for WIGOS are provided in ***Annex II***.

3.2 Project Plan

3.2.1 The *ad hoc* planning meeting drafted a project plan in a way consistent with the initial version of the WIGOS Concept of Operations (CONOPS) as proposed by the first meeting of the Executive Council Working Group on WIGOS and WIS[7] (Geneva, Switzerland, December 2007). The Project Plan defines the Terms of Reference of the joint JCOMM/IODE Steering Group to coordinate and facilitate the development and implementation of the JCOMM Pilot Project for WIGOS (including relevant WIS items) as well as the IODE ODP. The Project Plan was later refined by the first and second meetings of the joint Steering Group, Geneva, 18-19 September 2008, and Ostend, Belgium, 15-16 October 2009, respectively to take into account the later evolutions of the CONOPS.

3.2.2 The Project Plan provides for the scope and deliverables of the Pilot Project. The key deliverables further detailed in *paragraph 4* below and ***Annex III*** are:

- Document and integrate instrument best practices and related standards;
- Build marine data systems that are interoperable with the WIS; and
- Promote quality management and standards.

3.2.3 An initial budget for the Pilot Project with resources from both the WMO and IOC was proposed in the Project Plan. This reflected the ownership of both international Organizations in the Pilot Project.

3.2.4 The Project Plan provides details about the required coordination with the ICSU-IOC-UNEP-WMO Global Ocean Observing System (GOOS), as well as with the WMO Commission for Basic Systems (CBS), the WMO Commission for Instruments and Methods of Observation (CIMO), JCOMM and its Management Committee (MAN), JCOMM Observations and Data Management Coordination Groups, and ocean observations panels and associated programmes (i.e. DBCP, SOT, GLOSS, Argo, IOCCP, OceanSITES[8]), and the Committee for the International Oceanographic Data and Information Exchange (IODE) of IOC. The Project Plan lists all the bodies that are expected to have a direct role or responsibility in working with the Pilot Project Steering Group and provides details about their expected roles.

3.2.5 The Project Plan recalls that operational models of the interior of the oceans have been significantly improved with the success of the Argo profiling float Programme deploying an increasing number of instruments and having now attained the 3000 float target. A number of countries are engaged in combining multi-level atmospheric and oceanographic models and installing real-time modelling functions. With this ability, the oceanographic community is seeing important advantages to becoming involved in making, reporting and using ocean observations in real-time. The ocean observing components of JCOMM that are not currently reporting by way of

7: WIS: WMO Information System

8: See Annex for the list of acronyms

the GTS are encouraged to submit their data in real-time through the WIS as part of the Pilot Project activities.

3.2.6 It is also expected that the importance of historical data to modelling will increase. Historical data are valuable as tests of the ability of models to reproduce past conditions and so provide confidence that they can also make reliable predictions. In addition, providing higher-resolution, high-quality delayed-mode data that reach data centres in the ocean community will be important for hind casting conditions in areas that have been poorly sampled in the past by improving the forecasts of operational models that use real-time data only.

3.2.7 The Pilot Project considered the following aspects:

(i) Providing interoperable access, through the WIS and the IODE ODP, to historical and recent data holdings in ocean data centres.

(ii) At the same time that marine data managers were being approached to provide access to their data, they were encouraged to join the efforts in developing documentation in the form of discovery metadata, and standards and best practices for such data.

(iii) To recognize ownership of both the WMO and IOC marine and oceanographic observing systems, the development of regional marine and oceanographic instrument centres was proposed within the framework of JCOMM.

3.2.8 The Project Plan considered the benefits for the ocean community, WMO, and NMHS to participate in the Pilot Project and provide interoperability of ocean datasets with the WIS. These as well as benefits derived from the lessons learned in the framework of the Pilot Project legacy are detailed in *paragraph 5* below.

3.2.9 The Project Plan also lists the organizations and programmes from five countries which have shown interest in making commitment as partners in the Pilot Project. Potential partners are also listed. Identified partners were expected to provide for interoperability of specific ocean datasets with the WIS and/or the IODE ODP, as well as to contribute to standardization of instrument practices and traceability of the observations to standards. While the Steering Group was relatively small and focus on the project plan, a more comprehensive list of individuals was proposed in parallel as “participants” in the Project.

3.2.10 A detailed schedule for the Pilot Project activities and its joint Steering Group is outlined in the Project Plan for the period 2008 to 2010. Particular interactions with the JCOMM groups and panels were proposed, as well as with the WMO Executive Council Working Group on WIGOS and WIS, and its sub-Group on WIGOS. The Pilot Project is scheduled to terminate in late 2010 so that proper recommendations can be made to the Sixteenth Session of the WMO Congress in 2011.

3.2.11 The last version of the Project Plan is available from the Project web page[9].

3.3 Implementation Plan

3.3.1 Based on the Project Plan, the Pilot Project prepared a detailed “*Overarching Implementation Plan for the Ocean Data Portal (ODP) and the WIGOS Pilot Project for the IODE and JCOMM*” at the first meeting of the joint Steering Group for the IODE Ocean Data Portal (ODP) and the JCOMM Pilot Project for WIGOS (Geneva, 18-19 September 2008). The Implementation Plan was further reviewed and updated at the second meeting of the joint Steering Group (Ostend, Belgium, 15-16 October 2009). Further updating - based on the actions undertaken since October 2009 and to reflect progress, status of implementation, and updated

9: http://www.wmo.int/pages/prog/www/wigos/documents/Project_Plan_JCOMM.pdf

targets - was made by the third and last meeting of the joint Steering Group (Ostend, Belgium, 1-3-November 2010).

3.3.2 The Pilot Project was initiated in 2008 and had basically two years to complete. The Implementation Plan provides detailed information on the Pilot Project activities and actions proposed to implement the Project Plan. It does so by: first addressing each of the three key deliverables (see *paragraph 4* and ***Annex III***) separately, identifying specific tasks to each deliverable to be carried out by the joint Steering Group members and other experts as appropriate, and projecting a time line for each. A section addresses the requirement for overall project management tying together all activities needed to accomplish Pilot Project deliverables. A final section constructs a timeline of actions for the entire project.

3.3.3 The Implementation Plan also provides an updated and more detailed budget to that already provided in the Project Plan. It was especially noted that the actual cost of implementation will be higher and these will be borne by the participants in the project.

3.3.4 The Pilot Project is the contribution of JCOMM to the WIGOS / WIS developments of WMO as well as to the IOC / IODE ODP. The Implementation Plan addresses in detail how specific activities promoted under the WIGOS CONOPS can be translated to the marine community, and in particular as part of the Pilot Project.

3.3.5 Cooperation between the IODE and JCOMM, through its joint Expert Team on Data Management Practices (ETDMP), has resulted in the development of the End-to-End data management (E2EDM) technology that provides the functionality for building the distributed data system known as the Ocean Data Portal (ODP). The objective of the ODP is to facilitate and promote the exchange and dissemination of marine data and services. The ODP provides the full range of processes including data discovery, access, and visualization, and delivers a standards-based infrastructure that provides the integration of marine data and information from the network of distributed IODE NODCs and other participating systems.

3.3.6 The development of the ODP and its linking to the WIGOS objectives furthers the objectives of both JCOMM and IODE. The Pilot Project provides WIGOS with access to oceanography and marine meteorology data and products.

3.3.7 Other aspects not related to the ODP have also been addressed by the Pilot Project, including instrument practices and standards, and quality management.

3.3.8 The Implementation Plan explains the role of JCOMM in WIGOS, i.e.

(a) contributing to strategies to satisfy observational requirements from WMO Programmes and international partners through the WMO Rolling Review of Requirements (RRR) Process;

(b) contributing to strategies to guarantee system interoperability, including data quality of observing systems and instruments;

(c) evaluating existing WIGOS capabilities before developing, acquiring, and or deploying new observing systems or sensors;

(d) exploiting existing platforms and employs multi-sensor platform concepts to the maximum possible extent;

(e) coordinating requirements, plans and activities with all appropriate Technical Commissions, Regional Associations and Programmes; and

(f) building upon existing observing systems/networks as a global system of observing systems.

3.3.9 The WIGOS integration objective will be accomplished at three levels:

(i) Standardization of instruments and methods of observations (instruments and methods of observation level);

(ii) Common information infrastructure, (WIS data level); and

(iii) End-product (e.g., observations, analyzed fields, model output), quality assurance (QM / QA / QC product level), and standards needed to ensure data quality to project defined minimal requirements.

3.3.10 Standardization and interoperability, including data compatibility, are primary factors for enabling integration. JCOMM will meet several WIGOS sub-goals as follows:

- Improve the production, use and application of data and information from across all observing systems sponsored and co-sponsored by WMO, in a seamless way, to satisfy user requirements;
- Be designed to accommodate the diversity among Members with respect to their capabilities and needs;
- Through capacity-building, improve capabilities of Members to access and utilize observations and analysis products from all WMO and sponsored observing systems;
- Ensure compatibility, connectivity and interoperability including interface arrangements within and among all WMO and sponsored observing systems components and externally with other users;
- Allow for the continuous review of the requirements placed on the integrated system and have the capability to effectively adjust and respond to changing requirements;
- Ensure 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;
- Promote the development, testing and comparison of new observing capabilities and provide mechanisms to easily integrate them into WMO and sponsored operational observing systems;
- Ensure the optimum integration of the various components of all observing programmes;
- Increase efficiencies by reducing as far as possible redundancies and overlaps of systems and the management activities supporting them;
- Facilitate more rapid and efficient assimilation of technological advances and apply them as far as possible across all observing programmes;
- Foster co-location of observing sites of complementary systems as far as practical thereby reducing redundancies; and
- Ensure the involvement of the various scientific and user communities in the activities of setting requirements, and the monitoring and assessing system performance.

3.3.11 The Implementation Plan stresses that the Pilot Project shall respect the data policies of partner organizations, including those of both the WMO and IOC. The IODE and JCOMM 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 data and products including guidelines on relationships in commercial activities.

3.3.12 The last version of the Implementation Plan is available from the Project web page[10]. The status of the Implementation Plan as of November 2010 is provided in ***Annex IV***.

4) Deliverables, achievements, test of concept, and pending issues

10: http://www.wmo.int/pages/prog/www/wigos/documents/Impl_Plan_JCOMM.pdf

4.1 As part of the JCOMM strategy for 2010 to 2013, and WMO and IOC Strategic Planning and Strategic Objectives of WMO and IOC respectively, the Pilot Project will contribute to WMO Expected Results 3, 4, 6 and 7, and IOC of UNESCO Actions 2(a), 2(b), 2(c), 3(a), 3(c) and 4(a):

> "*Coordinate, develops, and recommends standards and procedures for the work of Members/Member States in the overall collection, management, exchanges and archival of high quality marine meteorological and oceanographic data, information and products, on which climate studies, predictions and services, as well as impact and adaptation strategies, are based.*"

4.2 Deliverables for the Pilot Project contributing to the JCOMM strategy above are described in detail in the Pilot Project Plan and Implementation Plan, and reproduced in ***Annex III***.

4.3 The Pilot Project included three key deliverables as detailed below:

Deliverable 1: Document and integrate instrument best practices and related standards among the marine meteorological and oceanographic communities.

4.3.1 The goal is to define and agree on common standards for instruments and methods of observation as well as subsequent organization and handling of the data and information to deliver consistent and better quality data to both the broad user and modelling communities. Data records must be traceable to standards. Maintenance and calibration are critical for ensuring stability and sustainability of systems. To understand system and component performance, a thorough documentation of observing platform siting and history as well as the recording and updating of metadata are critical in the elimination of inhomogeneities in data records. For example, one of the challenges proposed by the climate community was to conduct instrument intercomparisons over a long enough period, usually on the order of about 10 years. Best practices and standards have sometimes been developed separately between the oceanographic (e.g., sea level) and the marine meteorological (e.g., voluntary observing ships) communities and there was no clear connection. However, there are instances where these have been developed in common between the WMO and IOC (e.g., ships of opportunity and data buoys). Much work still remains to be undertaken.

4.3.2 Some documentation of instrument related standards already exists. The Pilot Project worked to identify instrument standards and best practices that are relevant to WIGOS, identify those publications that need updating, and make recommendations for updating them. Updating existing standards or developing new ones will be made in a way consistent with the process that has been developed jointly by JCOMM and IODE and administered by the ETDMP.

4.3.4 To achieve integration of instrument best practices, the Project Plan promotes the establishment of instrument centres dedicated to marine and other appropriate oceanographic instruments. Such centres will facilitate having all WIGOS observational data and metadata and processed observational products to adhere to WIGOS standards for instruments and methods of observation as well as standard observing network practices and procedures. This effort will assist in the exchange of data via WIS using agreed upon data and metadata representation forms and formats. They will be essential for monitoring instrument performance, calibration procedures, providing assistance with regard to intercomparisons, as well as providing for appropriate training facilities that would complement what the manufacturers are currently providing. Invited ocean experts will be in a position to provide required training. CIMO has experience in this regard and has assisted the Pilot Project in the establishment of such centres[11]. Links will be established with the climate community as climate instrument centres have also been developed. The Pilot Project proposed cooperation with the Association of Hydro-Meteorological Equipment Industry (HMEI[12]) – who was invited to contribute to the Pilot Project – to explore its role in evaluating and documenting instrument performances.

11: http://www.wmo.int/pages/prog/www/IMOP/IMOP-home.html
12: http://www.hydrometeoindustry.org/

4.3.5 The WIGOS CONOPS recommends that all WIGOS observational data and metadata (including instrument/platform metadata and discovery metadata) should adhere to WIGOS standards and be exchanged via WIS using agreed upon data and metadata representation forms and formats. Routinely collected instrument/platform metadata is an essential practice, which enhances observational data traceability to standards, helps to correctly interpret the data and increases data coherence (e.g. information about sensor height is essential for appropriate data assimilation). Such metadata also permits improved effectiveness of climate applications, and facilitates quality-monitoring activities and instrument intercomparisons. Within JCOMM DMPA, there is the Water Temperature instrument/platform Metadata (META-T) Project. One of the objectives of META-T is the consolidation of instrument and other metadata to describe sea temperature measurements. There are two centres contributing infrastructure to this project, one in the United States and the other in China. The Pilot Project considered how to include this work, and proposed a strategy for including variables other than Sea Surface Temperature and water temperature profiles in the platform / instrument metadata collection, distribution, and archiving system being developed.

4.3.6 Test of concept and the following achievements regarding deliverable 1 were realized through:

(i) A Strategy was proposed for the review of the WMO and IOC Technical Publications in light of the goals of the Pilot Project and focused mainly on the activities related to instrument practices. To test concept, the DBCP offered to provide funding for hiring a consultant to review these Publications from a limited number of variables perspective (e.g. Sea Surface Temperature, SST). The SOT Task Team on Instrument Standards is also contributing and providing input. The strategy proposed by the Pilot Project is reproduced in ***Annex VII***. The following Publications are targeted:

- IOC Manual and Guides No. 4, Guide to Oceanographic and Marine Meteorological Instruments and Observing Practices
- IOC Manual and Guides No. 26, Manual of Quality Control Procedures for Validation of Oceanographic Data
- WMO Publication No. 544, Manual on the Global Observing System (GOS)
- WMO Publication No. 488, Guide on the Global Observing System (GOS)
- WMO Publications No. 8, Guide to Meteorological Instruments and Methods of Observation

(ii) Comprehensive updating of the marine chapter of the WMO Guide on Meteorological Instruments and Methods of Observation (WMO No. 8, CIMO Guide) by the JCOMM Ship Observations Team (SOT) and the Data Buoy Cooperation Panel (DBCP). Changes were then reviewed by CIMO, and submitted for comment to WMO Members by way of a letter. Feedback from Members has been included, and a revised version of the CIMO guide submitted to the fifteenth Session of CIMO (Helsinki, Finland, 2-8 September 2010) and approved. The changes are about to be published[13].

(iii) At its fifth Session, the SOT agreed to stop the pilot phase of the Voluntary Observing Ship (VOS) Climate Project (VOSClim), and to integrate the VOSClim in the wider VOS. To realize this, a thorough review of the chapter describing the Voluntary Observing Ship Scheme in WMO Publication No. 471, Guide to Marine Meteorological Services, was made to add a new class of vessel for the VOSClim, and propose further changes that consider modern practices for the VOS Scheme. These changes have been approved by JCOMM-III.

(iv) The Ocean Data Acquisition System (ODAS) Metadata Service (ODASMS)[14] is provided by the National Marine Data and Information Service (NMDIS) of China. The Information

13: http://www.wmo.int/pages/prog/www/IMOP/publications/CIMO-Guide/CIMO_Guide-7th_Edition-2008.html
14: http://www.odas.org.cn/

Service Bulletin on non-drifting Ocean Data Acquisition Systems is being transferred from Integrated Science Data Management (ISDM), Canada to NMDIS.

(v) Adoption by the third JCOMM Session of Recommendation 3 (JCOMM-III[15]) — Provision of ODAS and Water Temperature Metadata. It recommends (i) Members/Member States to record and provide to the ODASMS on a routine basis appropriate metadata about ODAS platforms that they operate; (ii) Members/Member States to provide to China and the USA on a routine basis appropriate metadata about water temperature instrumentation that they use; (iii) China and the USA to expand their Meta-T facilities to include the management of metadata related to other ocean variables than water temperature; and (iv) The JCOMMOPS to routinely contact platform operators so that the metadata are being submitted to the ODASMS, including for operational platforms and for historical ones.

(vi) A number of BUFR[16] templates that are used for the encoding and distribution of marine meteorology and oceanographic data on the Global Telecommunication System (GTS) have been reviewed, and proposals made so that they included appropriate metadata. To test concept, the BUFR template for Expendable Bathythermograph (XBT) and Expendable Conductivity/Temperature/Depth (XCTD) has been reviewed, many changes proposed, and the new proposed version accepted by the CBS Inter Programme Expert Team on Data Representation and Codes (IPET-DRC) for validation at its September 2009 meeting.

(vii) Establishment by JCOMM Session of WMO-IOC Regional Marine Instrument Centres (RMIC) with their Terms of Reference. Adoption by the Third Session of JCOMM of Recommendation 1 (JCOMM-III) – WMO-IOC Regional Marine Instrument Centres, which defines Terms of Reference of an RMIC, including capabilities and corresponding functions, and a mechanism for formal WMO and IOC designation of an RMIC. JCOMM Recommendation is reproduced in ***Annex V***. JCOMM stressed that a regular review of the RMICs capabilities should be organized by JCOMM. It agreed that the established procedure for designing an RMIC should be included into the *WMO Guide to Meteorological Instruments and Methods of Observations* (WMO-No. 8). The formal process proposed by the Pilot Project for adopting RMICs has been discussed and agreed upon at the eighth Session of the JCOMM Management Committee, Paris, France, 16-19 November 2010, and is detailed in ***Annex VI***.

(viii) The National Data Buoy Centre (NDBC) of the National Oceanic and Atmospheric Administration (NOAA), USA offered to act as an RMIC on a trial basis and organized a successful JCOMM training workshop on marine instrumentation for the WMO Regional Association IV at NDBC from 13 to 15 April 2010 to prove concept. The feedback received from the participants has been excellent, demonstrating the demand that existed in developing countries for more training on instrument practices and standards, quality assurance, marine observing programme management and operational aspects, and data exchange. The workshop initiated new collaborations with the view to improve availability of ocean observations from the Regional Association, as well as the quality and traceability to standards of the corresponding data.

(ix) Closer links were established with the manufacturers of ocean measuring instruments. Many are now regularly attending Data Buoy Cooperation Panel (DBCP) and Ship Observations Team (SOT) meetings. HMEI was invited to attend the fifth SOT meeting and has usefully contributed to the work of the Session. HMEI also attended the third meeting of the joint Steering Group for the IODE Ocean Data Portal and the JCOMM Pilot Project for WIGOS (Ostend, 1-3 November 2010).

4.3.7 Pending issues regarding deliverable 1:

15: JCOMM-III: Third Session of JCOMM, Marrakech, Morocco, 4-12 November 2009

16: BUFR: Binary Universal Form for the Representation of meteorological data; a table driven code format used by WMO for the distribution of time-critical data

(a) USA (NDBC) and China (NMDIS) developed two mirrored instrument/platform metadata servers for water temperature observations as part of the META-T Pilot Project activities. However, these developments have not been entirely satisfactory but permitted to learn lessons. A strategy of developing metadata servers in close cooperation with platform operators should now be pursued. For example, a tide gauge metadata service should be developed by an operator within the tide gauge community or at least closely coordinated by the JCOMM Global Sea-level Observing System (GLOSS) Group of Experts. Similarly, the drifting buoy metadata service should be developed by or in close coordination with the DBCP/Global Drifter Programme.

(b) Regarding the management of Voluntary Observing Ship (VOS) instrument/platform metadata, the Pilot Project recommended to have WMO Publication No. 47 regulatory part included in the future WIS or WIGOS manual, and the ship metadata regarded as data as part of WIS. This recommendations was accepted by the fifth Session of the JCOMM Ship Observations Team (SOT-V, Geneva, Switzerland, 18-22 May 2009), and by the second meeting of the Sub-Group of the WMO Executive Council Working Group on WIGOS and WIS (Geneva, Switzerland, 19-23 October 2009). JCOMM and CBS should now work together to make a proposal at CBS Session in 2010.

(c) Initiation of a discussion regarding the scope for marine instrument intercomparisons in cooperation with CIMO, and based on the experience of CIMO. Information on why and how intercomparisons should be organized is stated in the CIMO Guide (WMO-No. 8, Chapter III.4). At present, there is much experience in calibration or test laboratories and on sites on land, but experience is very limited with intercomparisons on site on sea. Moreover no international intercomparisons were organized by CIMO dealing with instruments typically developed to measure marine operational variables. Therefore it was proposed to review and update the particular chapter in the CIMO Guide. Manufacturers, through HMEI, should play a substantial role in the future with regard to marine instrument inter-comparisons. For example, HMEI can provide equipment through Members. There is a need to develop JCOMM guidelines for marine instrument intercomparisons. The DBCP Pilot Project on Wave Measurement Evaluation and Test (PP-WET) has started intercomparison of wave measuring buoys and was asked to provide input in drafting generic guidelines for marine intercomparisons as a deliverable of the Pilot Project. The Surface Marine programme (E-SURFMAR) of the Network of European Meteorological Services (EUMETNET) was also asked to help with regard to VOS data. Efforts will be coordinated between JCOMM and the CIMO Management Group.

(d) Good progress was made with regard to updating the BUFR template for VOS data so that it includes appropriate instrument/platform metadata. The BUFR template for buoy data needs to be reviewed for the same purpose. These changes will be submitted to the IPET-DRC to permit validation, and future approval by the CBS. At the same time, the JCOMM DMPA Task Team on Table Driven Codes is introducing ocean variable based BUFR sequences to include data and instrument/platform metadata to be reported in real-time. The plan is to eventually use the same BUFR sequence for a given variable in most ocean related BUFR templates. However, this effort will take time, and the migration to table driven codes to be completed in 2012 is pressing on so priority is place on completing the BUFR templates on a platform type basis.

(e) At JCOMM-III China and Morocco expressed interest in eventually offering RMIC facilities at the National Center of Ocean Standards and Metrology (NCOSM, China), and the National Meteorological Service (Morocco) respectively. Contacts have been made informally with other countries for establishing RMICs in other regions. Specific training workshops and/or intercomparisons should be organized at RMICs. The formal adoption process as proposed by the Pilot Project and detailed in ***Annex VI*** needs to be approved by JCOMM-IV.

(f) Following the Pilot Project recommendation, JCOMM-III considered the HMEI could be a mechanism to represent manufacturers within the WMO and IOC through JCOMM, and therefore suggested that the HMEI could be given similar status within the IOC as those non-governmental organizations that were already granted consultative status by WMO. This will allow: (i) future interaction, cooperation and collaboration of HMEI with both the WMO and the IOC, including JCOMM Expert Teams and Panels; and (ii) the participation of HMEI in specific JCOMM activities such as pilot projects, technology developments, instrument evaluations, and intercomparisons. Manufacturers of ocean measuring equipment will be invited to participate in the HMEI. This can be realized by way of a Memorandum of Understanding between the IOC and the HMEI. The Pilot Project invited the IOC and the HMEI to pursue negotiation in this regard.

Deliverable 2: Build marine data systems that are interoperable with the WIS in close cooperation with the IOC ocean community.

4.3.8 The ultimate goal is to provide access to marine meteorological and oceanographic data and information to serve a number of applications, including climate, in an integrated way via the WIS and thereby facilitating access to well documented and standardized data. Despite WMO Resolution 40[17] (Cg-XII), which designates marine data as essential, currently it is difficult for the oceanographic community to access the Global Telecommunication System (GTS) in order to obtain marine observations in real-time or delayed mode as well as providing data for circulation on the GTS.

The Pilot Project targeted the following:

(i) To develop the IODE ODP based on the End-to-End technology previously developed by JCOMM thanks to the support of the Russian Federation NODC;
(ii) To make the ODP interoperable with the WIS as a Data Collection or Production Centre (DCPC);
(iii) To invite all IODE NODCs to contribute to the ODP;
(iv) To invite additional agencies holding datasets of interest to WMO programmes and co-sponsored programmes to contribute data and to ensure their data systems are interoperable with the ODP and/or the WIS. The lists of potential datasets were qualified by potential, meaning those that appeared to be available, and tentatively committed, meaning those that were prepared to initiate discussions to assess the resource implications of their participation.

4.3.9 Test of concept and the following achievements regarding deliverable 2 were realized through:

(a) The IODE ODP[18] has been designed to be interoperable with the WIS as a DCPC. The ODP will be developed in two phases -version 1 (v1) and version 2 (v2). v1– which is installed at the IOC Project Office for IODE, Ostend, Belgium – initial capabilities are based on the technical specifications and software of the End-to-End Data Management (E2EDM) technology developed by the JCOMM/IODE Expert Team on Data Management Practices (ETDMP) and the Russian NODC. ODP v1 implements the following functions: communication with data sources, discovery, visualization, content management and administration providing on-line access to and fusion of distributed marine data:
    - at operational and delay-mode time scales,
    - at various processing levels (observation, climate, analysis and forecast),
    - across oceanographic and marine meteorological disciplines, and

17: http://www.wmo.int/pages/about/Resolution40_en.html

18: The IODE ODP is not competing with national or regional data portal systems but aims at federating such heterogeneous systems. Only in countries or regions where no distributed data networks are in existence will IODE ODP offer a full solution.

- from multiple data source formats and storage systems (Data Base Management System, structured and non structured data files).

The ODP v1 architecture is based upon the well-known "client-server with mediator and wrappers" concept also known as "virtual data holdings or virtual organizations". The Data Provider, Integration Server and Portal services were substantially improved and expanded with new functionality. In addition, web-service communication between the Integration Server and Data Provider has been developed. A Geographical Information System (GIS) service – permitting interactive and fast presentation of multidisciplinary data and products – has also been added to the functionality of ODP. ODP v2, which will be fully compliant with international interoperability standards, is due for release in 2011. An overview of the current status of the Ocean Data Portal is provided in ***Annex IX***.

(b) In order to respond to security concerns expressed by some Members/Members States the light Data Provider (LDP) has been developed for the ODP. The LDP is an extension of the Data Provider functionality of the ODP which allows integration of data from data centres unable to install the Data Provider software. LDP offers remote registration of local datasets and provides deployment of the ODP distributed data system without software installation at the data centre side. The LDP allows participating organizations to generate the appropriate discovery metadata files and to remotely load local data into ODP distributed data system, thus providing interoperability with the IODE ODP and the WMO WIS. See ***Annex IX*** for details.

(c) Documentation and two web sites have been developed for the IODE OceanDataPortal, (i) the ODP website[19] which provides basic information for general users, technical information (Data Provider software, manuals and documentation, services, formats and dictionaries), a discussion forum, Frequently Asked Questions (FAQ) and training materials; and (ii) the ODP portal site[20] which provides access to data from the contributing organizations, including the discovery service, viewing service, analysis service and download service.

(d) A meeting was held between the WIS PO and the ODP developers (18-19 March 2009, Obninsk, Russian Federation) to address ODP and WIS technologies and interoperability issues in order to refine ODP v1 and to produce a plan for ODP v2. The meeting noted that most of the 15 WIS technical specifications interoperability requirements are met by ODP. However, compliance will need to be demonstrated in more detail.

(e) Strong links have been established between the ODP and the Pan-European infrastructure for Ocean & Marine Data Management (SeaDataNet[21]). Specifications of the ODP-SeaDataNet interoperability interfaces based on portal-to-portal interaction have been proposed and summarized in the document "Technical Specifications of the IODE Ocean Data Portal and SeaDataNet interoperability".

(f) Three training courses were organized related to the development of IODE ODP data providers:

- The *Training Course on the Establishment of National Ocean Data Portal nodes in the Black Sea region (ODINBlackSea)* was held from 20-21 March 2009 in Obninsk, Russian Federation. Five ocean data centres from Bulgaria, Romania, Russia and Ukraine participated in the course. As a follow-up to the course, in April 2009, five institutions of the ODINBlackSea group joined as IODE Ocean Data Portal data providers: Bulgarian National Oceanographic Data Centre (BGODC/IO-BAS), Institute of Biology of the Southern Seas National Academy of Sciences of Ukraine (IBSS), Marine Hydrophysical Institute National Academy of Sciences of Ukraine (MHI), National Institute for Marine Research and Development (NODEC/NIMRD) and All-Russia Research Institute of Hydrometeorological Information - World Data Centre

19: http://www.oceandataportal.org
20: http://data.oceandataportal.org
21: http://www.seadatanet.org/

(RIHMI-WDC).

- The *First IOC WESTPAC Training Course on the Establishment of National IODE Ocean Data Portal Nodes* was held from 31 August – 4 September 2009 in Seoul, Republic of Korea. There were 10 participants from Republic of Korea, Japan, Malaysia, Thailand, Indonesia and Vietnam. During the training course each participant installed Data Provider software and created 3-5 information resources (metadata records). A small local training federation with Integration Server and 10 Data Provider was tested. Results were viewed through the local version of Ocean Data Portal user interface. Participants expressed their interest in contributing to the IODE ODP. Additional follow-up was carried out to assist with establishing data provider nodes in the participating institutions. In addition China, unable to participate in the course, was invited to establish data providers.

- The *Training Course on the Establishment of National Ocean Data Portal Nodes in the Black Sea region (ODINBlackSea) for Georgian and Turkish NODCs* was held from 21-23 December 2009 in Istanbul, Turkey. The aim of this course was to extend the number of data providers in the Black Sea region and to establish an ODP regional node.

(g) Regarding provision of interoperable datasets via the ODP and/or WIS, the primary focus has been on contributions from the NODC of the IODE. However, the set of data providers was also expanded to programmes contributing to WMO programmes and co-sponsored programmes. Following a joint WMO-IOC letter proposed by the Pilot Project, commitments were made by a number of countries and agencies for connecting ocean datasets to the ODP and/or WIS. ODP and WIS experts have also been providing technical assistance to agencies, including visits and workshops. The list of datasets that will be contributed to the IODE ODP and/or WIS by partner organizations and programmes as part of the JCOMM Pilot Project for WIGOS is provided in the table below:

Datasets	***Agency(ies)***	***Target[22]/Status***
Global Temperature and Salinity Profiles from the GTSPP[23]	US NODC	Done
World Ocean Atlas[24]	US NODC	End 2010/Submitted
Surface currents from HF radar	US NDBC	End 2010
High Resolution Sea Surface Temperature from GHRSST[25]	US NODC	End 2010/Submitted
Data extracted from ESIMO[26] – real-time GTS data and product (air temperature, wind, wave, sea level, current, water temperature, salinity, oxygen)	Russian Federation NODC	Done
Upper-ocean T & S gridded *in situ* fields	Canada ISDM	Done
Ocean surface observations measured from surface drifters	Canada ISDM	End February 2011
Sea level data from PSMSL[27]	UK BODC	2011/Under discussion
Marine Climatological Summaries and Global Collecting Centres (GCCs)	UK Met Office, and DWD, Germany	Done[28]
Blended-quality climatology products (ICOADS[29]	US NOAA/NCDC,	End

22: Date when the connection should be realized for those centres that recently provided positive response
23: GTSPP: Global Temperature and Salinity Profile Programme, http://www.nodc.noaa.gov/GTSPP/
24: http://www.nodc.noaa.gov/OC5/WOD09/pr_wod09.html
25: GHRSST: The Group for High Resolution Sea Surface Temperature, http://www.ghrsst.org/
26: http://www.ocean.ru/eng/content/view/31/39/
27: PSMSL: Permanent Service for Mean Sea Level, http://www.pol.ac.uk/psmsl/
28: For the UK GCC
29: ICOADS: International Comprehensive Ocean-Atmosphere Data Set, http://icoads.noaa.gov/

monthly summaries) - currently extending through May 2007 in NetCDF format	and NOAA/ESRL	2010/Under discussion
Ocean datasets from AODN[30]	AODCJF	end 2010
ODAS Metadata Service	China NMDIS	Done
Argo profiling float T&S data	France & US GDACs	End 2010/will be using LDP[31]

4.3.10 Pending issues regarding deliverable 2:

(a) Although most of the 15 WIS technical specifications interoperability requirements are met by ODP, compliance will need to be demonstrated in more detail.

(b) Development of ODP v2 to be completed. v2 will be fully compliant with international interoperability standards and tools. It will move away from standalone web-services, to implement and standardize methods and means of interface interaction. It will allow unified access to services that belong to the ODP organizations and systems (e.g., SeaDataNet, WIS) and will be based on international standards (the Open Geospatial Consortium - OGC[32], and the World Wide Web Consortium - W3C[33]).

(c) Developments initiated by a number of countries as listed above need to be completed, and effective interoperability with the ODP and/or WIS initiated.

(d) Agencies holding the following datasets should be approached and invited to contribute their datasets through the WIS and/or the ODP:

- Profiling float water temperature and salinity data (Argo programme);
- Deep ocean time-series reference stations data (Ocean Sustained Interdisciplinary Timeseries Environment observation System - OceanSITES);
- Tropical moored buoy data (Tropical Moored Buoy Implementation Panel - TIP);
- Drifter data (Data Buoy Cooperation Panel - DBCP);
- Ship-based observations (Ship Observations Team – SOT – and its Voluntary Observing Ship scheme – VOS – Automated Shipboard Aerological Programe – ASAP- and the Ship of Opportunity Programme - SOOP);
- Tide gauge data (Global Sea-level Observing System - GLOSS);
- Surface underway data (Global Ocean Surface Underway Data Pilot Project - GOSUD); and
- Ocean carbon data (International Ocean Carbon Coordination Project - IOCCP),
- Datasets from the Pan-European infrastructure for Ocean and Marine Data Management (SeaDataNet);
- Ocean Tracking Network data (OTN);
- Ocean Biogeographical Information System data (OBIS);
- Ocean Surface Vector Wind virtual constellation data (OSVW - Committee on Earth Observation Satellites -CEOS)
- etc.

(e) Complete training materials, and organize additional training workshops on ODP and WIS technologies, particularly at the IODE Project Office in Ostend, Belgium.

Deliverable 3: Promote quality management and standards, in particular through establishing compliance with the WMO Quality Management Framework (QMF)

30: AODN: Australian Ocean Data Network, http://aodn.org.au/
31: LDP: ODP light Data Provider
32: http://www.opengeospatial.org/
33: http://www.w3.org/

4.3.11 The goal was to coordinate the development of cost-effective Quality Management System (QMS) by Members and to propose practical solutions or examples. At different steps of the data production line, it is expected that improved quality management will provide the following benefits:

(i) more quality data to meet the requirements of a broad and varied community of users;

(ii) data quality and the conditions under which the measurements are made will be known;

(iii) improved data quality as well as their consistency due to the wider acceptance of documented standards;

(iv) more timely data will reach targeted applications and data assimilation systems;

(v) data duplication will be avoided and the origin of the data identified;

(vi) increased trust in the data by users; and

(vii) improved products and services using these data.

4.3.12 The goal of the Pilot Project was to facilitate achievement of these benefits through the following:

(i) The development and implementation of the QMS that complies with the WMO and IOC quality policies was promoted in the context of the Pilot Project with the recommendation to compile, at the national level, regulatory documentation produced in a way consistent with the eight Quality Management Principles[34] developed under ISO Technical Committee 176 (TC176), Sub-Committee 2 (SC2), Working group 12 (WG15): User / customers focus, Leadership, Involvement of people, Process approach, System approach to management, Continual improvements, Factual approach for decision making, and Mutually beneficial supplier relationships. This may lead in some instances to the certification of such QMS related to the products using the observational data. ISO 9001 certification will be not be mandatory, as some of the meteorological and / or oceanographic services participating in the Pilot Project might wish to comply with other standards than ISO;

(ii) Better access to data will be achieved through: (i) interoperability arrangements between the ocean and meteorological communities (deliverable 2); (ii) establishing procedures to manage duplicate data and methods for avoiding them; and (iii) collection and distribution of instrument / platform metadata (part of deliverable 1);

(iii) The IODE/JCOMM Standards process also provided a framework for the Pilot Project to further the development of appropriate widely accepted quality management standards to address issues such as instrument best practices, real-time and delayed-mode quality control procedures (automatic and / or manual), data collection and exchange formats, and products using the observational data; it must be noted that this item also relates to deliverable 1 but is not limited to instrument best practices and standards;

(iv) The Pilot Project assisted in the production of a catalogue on JCOMM best practices and standards to be published as a JCOMM Technical Document. The

34: http://www.iso.org/iso/iso9000-14000/understand/qmp.html

Pilot Project has been using both the IODE OceanTeacher training facility and the new WIGOS web site to share appropriate documentation;

(v) Quality Management issues related to instrument best practices have been addressed under deliverable 1.

4.3.13 Test of concept and the following achievements regarding deliverable 3 were realized through:

(a) Adoption by the third JCOMM Session of Recommendation 8 (JCOMM-III) — Implementation of Quality Management Systems for Met-Ocean Data, Products and Services by Members/Member States. It is recommending Members/Member States (i) to propose and implement quality management systems for met-ocean data, products and services, based on the IODE/JCOMM Standards Process, the WMO Quality Management Framework and the principles of ISO or any relevant quality management standards, as appropriate to their circumstances; (ii) to participate in ISO activities through their appropriate national channels and to assist WMO and IOC in the development of common standards with ISO, within the framework of the WMO-ISO Working Arrangements; (iii) to share relevant experience and cooperate with one another, as appropriate, in developing quality management systems, including assisting Members/Member States with specific quality management system implementation needs; (iv) to collaborate with the Inter Commission Task Team on Quality Management Framework (ICTT-QMF) in furthering this approach of peer reviews as an example of effective implementation of the WMO-wide QMF; and (v) to submit their common practices in collecting, managing and exchanging oceanographic and marine meteorological data though the IODE/JCOMM Standards Process.

(b) The establishment of a JCOMM/IODE Ocean Data Standards[35]; and adoption by the third Session of JCOMM of Recommendation 4 (JCOMM-III) — Development of Data Management Standards. It is recommending Members/Member States (i) to submit their proposals to the JCOMM-IODE Ocean Data Standards Pilot Project (ODS) for wide community adoption; and (ii) to implement the recommended standards in agencies in their own countries at the earliest possible date. A proposal to Adopt ISO 3166-1 and 3166-3 Country Codes as the Standard for Identifying Countries in Oceanographic Data Exchange has been submitted through the standards process and published through UNESCO Manuals and Guides 54. Two additional proposals have been submitted in the second quarter of 2010 for consideration and adoption as community wide standards: (i) 'The Proposal to adopt ISO 8601:2004 as the standard for the representation of Dates and Times in Oceanographic Data Exchange', and (ii) 'The Proposal to adopt the SDN Common Data Index metadata profile (CDI) as a Standard for Oceanographic Data Exchange'. A fourth proposal for ISO 6709 (latitude, longitude) was planned for submission in December 2010.

(c) A consultant was hired in early 2009 to review publications that relate to JCOMM standards and practices, and coordinate production of a catalogue. The catalogue was published on the web[36], reviewed by JCOMM-III, and includes about 60 publications. The consultant also made the following recommendations for updating and harmonizing standards:

General Recommendations:

1. All JCOMM Panel and Expert Teams should review the publications and documents identified for their teams for standards development and accreditation, and in particular deficiencies, duplication, discrepancies, potential for cross-referencing, and make recommendations to address those issues;
2. The IOC should review the publications and documents identified for their teams for

35: http://www.oceandatastandards.org
36: http://bestpractice.iode.org/

standards development and accreditation, and in particular deficiencies, duplication, discrepancies, potential for cross-referencing, and make recommendations to address those issues.

Specific Recommendations:

1. Each publication in the spreadsheet (submitted by the contractor) has a specific status that needs to be reviewed and updated (63 documents in all);
2. The IODE/JCOMM Expert Team on Data Management Practices (ETDMP) need to create and submit their publication for inclusion in the JCOMM Catalogue;
3. The finalized spreadsheet should be converted to a database by the IODE Project Office using FileMaker and placed on an IODE server for review and comment (this has been implemented).

4.3.14 Pending issues regarding deliverable 3:

(a) Follow up implementation of Quality Management Systems for Met-Ocean Data, Products and Services by Members/Member States according to Recommendation 8 (JCOMM-III).

(b) Complete the review of the two standards submitted in early 2010, and submit additional standards through the Standards process (Recommendation 4 (JCOMM-III)), and seek wide community review.

(c) Address the recommendations from the consultant regarding JCOMM best practices and standards.

(d) Existing documentation on GDACs needs to be reviewed and added in the JCOMM catalogue.

4.4 In addition, the following has been realized by the Pilot Project:

- Three meeting reports, and a workshop report which can be found on the project web page[37];
- The Project Plan (also available from the project web page[38]);
- The Implementation Plan (also available from the project web page[39]);
- This project report that may be used by the directors of NMHS and Oceanographic institutes to make the case at the national level for engaging in the necessary developments, funded nationally, to meet the requirements for the Pilot Project;
- A comprehensive analysis of strengths and weaknesses in the management of ocean observing systems leading to some recommendations (see *paragraph 6*);
- Active participation of JCOMM in the CBS Rolling Review of Requirements (RRR) process and provision of input to the WMO Database (instrument performances and requirements).

5) Benefits of WIGOS integration regarding oceanographic observations for NMHSs, NODCs, and ocean data users

5.1 Introduction

5.1.1 WMO Member countries and Member States of partner organizations such as IOC of UNESCO will benefit from the integration of marine meteorological and other appropriate oceanographic observations into WIGOS in a number of ways as described below. Some benefits, in particular at the Observing Systems implementer level, have already been realized to some extent through the Pilot Project.

37: http://www.wmo.int/pages/prog/www/wigos/marine_pp.html
38: http://www.wmo.int/pages/prog/www/wigos/documents/Project_Plan_JCOMM.pdf
39: http://www.wmo.int/pages/prog/www/wigos/documents/Impl_Plan_JCOMM.pdf

5.1.2 Benefits will be realized at different levels for different types of actors, i.e.

(i) Those implementing and operating the observing networks, producing the data, and making them available (i.e. mainly specific services within NHMSs and Oceanographic Institutes);
(ii) Those using ocean observations in real-time and delayed mode to deliver products and services (i.e. mainly governmental agencies such as NMHSs and private companies); and
(iii) The general public and end users benefiting from those products and services.

5.1.3 Benefits can also be categorized as following:

- Reduced financial demands on Members
- Better products and services
- Increased visibility for Members producing ocean observations, and related products and services
- Better research for future applications

5.2 Reduced financial demands on Members

5.2.1 Reduced financial demand on Members is expected to be realized in the following ways:

Network optimization

5.2.2 The Rolling Review of Requirements (RRR) is part of the WIGOS integration process. The ocean community is participating in this exercise and has already contributed substantial input in terms of (i) requirements and statement of guidance for ocean applications, and (ii) estimates of ocean instrument performances.

5.2.3 The RRR promotes a cost-effective management of the existing resources through prioritization and recommendations for the deployment of instruments that are believed to substantially impact the end products for each application. Through WIGOS integration, the RRR, better monitoring and evaluation of ocean observing networks efficiency (e.g. JCOMM metrics), and the further development of coordination and synergies between disciplines (e.g. meteorologists and oceanographers deploying multi-purpose observing platforms), the observing networks should become better assimilated, and therefore more cost-effective.

5.2.4 The Pilot Project felt that the RRR should be more open, and receive more substantial input from the ocean community in the critical review and production of the statements of guidance of appropriate application areas (e.g. ocean applications, seasonal to inter-annual forecasting). This should permit increased ownership by the ocean community of WIGOS, and facilitate further sharing of the data by specific projects (mainly from the oceanographic research community) not presently contributing data.

5.2.5 The WIS and ODP will provide multi-disciplinary access to data, permitting cost-savings based on synergies between disciplines (e.g. less human resources spent on data discovery and access activities as data will be more visible and better accessible).

Integration of in situ and satellite observations

5.2.6 Integration of *in situ* and satellite observations can be addressed in terms of:

- Modern Numerical Weather Prediction (NWP) models are now capable for some instruments of assimilating radiance information from satellite products directly without having to derive observations in geo-physical units before assimilation.
- In other cases, complementarity of *in situ* and satellite observations for data assimilation in the numerical models is still required. Some variables cannot presently be easily derived

from satellite products (e.g. sea level pressure) while other variables observed by satellites require sparse *in situ* ocean observations for ground (or surface) truth or bias correction.
- *In situ* observations are required for the calibration and validation of satellite products;
- Mixed products based on virtual satellite constellations are now assimilating observations from various satellite sources, as well as from *in situ* data (e.g. the Group for High Resolution SST – GHRSST). JCOMM should be promoting the development of pilot activities to deploy *in situ* instrument that provide for higher resolution data in targeted geographical areas in order to better understand the impact of *in situ* observations on satellite products, and better estimate the quality of the *in situ* observations. Such pilot activities would permit to better understand complementarity between *in situ* and satellite systems, and help to define strategies for *in situ* networks optimization;
- Satellite products provide useful quality information regarding *in situ* observing systems that are useful to platform operators for taking corrective action (e.g. removing platform data from GTS distribution, or correcting their biases, in case systematic errors are detected). *In situ* observations can also provide useful quality information for tuning the satellite products.

5.2.7 Such strategies are expected (i) to optimize the utility of complimentary *in situ* and satellite observing networks, leading to enhanced return on observing system investments, and (ii) to enhance the quality monitoring of the *in situ* networks, permit bias correction, production of uncertainty estimates, and therefore permit to use observations from certain [biased] platforms that could not be used otherwise, hence maximizing data return of the networks and possibly deploy less platforms and make savings.

More cost-effective implementation and operations of the observing networks

5.2.8 Through the use of standardized ocean observations equipment, and an enhanced cooperation with the manufacturers, it is expected that the manufacturers will be able to reduce the cost of the instruments.

5.2.9 Better integration and cooperation between NMHSs, oceanographic institutes, and other partners will facilitate synergies and the sharing of available resources for the implementation and operations of the observing networks. This can be realized through:

- Sharing of common observing platforms to serve multiple applications;
- Sharing of calibration infrastructures (e.g. RMICs);
- Sharing platform deployment opportunities and logistical facilities;
- Sharing of satellite data telecommunication costs (the same channel for all observations);
- Sharing of facilities producing quality information;
- Sharing of resources for the recovery of instruments at sea (for post-calibration, and instrument evaluation, and investigation of detected problems permitting tuning of the technology);
- Sharing of resources for training and Capacity Building permitting to bring more partners in the system and make savings (see PANGEA concept below).

5.2.10 The use of standardized equipment, and the sharing of WMO-IOC RMICs can provide substantial savings in terms of instrument calibration, and intercomparisons, in particular for developing countries.

5.2.11 The manufacturers will be expected to provide expertise, and lend hardware for the conduct of instrument intercomparisons as a contribution to the WMO-IOC RMICs. This is expertise and hardware that NMHSs won't have to provide themselves, hence permitting to make savings.

5.2.12 Satellite data telecommunication costs for the transmission of observations from the platforms at sea to data processing centres on land will be reduced thanks to establishment of an international forum of users of satellite data telecommunication systems to address tariff

negotiations, user requirements, and making recommendations on deficiencies and gaps related to the use of such systems.

5.2.13 The Partnership for New GEOSS Applications (PANGEA) concept proposed by JCOMM builds on and complements other existing capacity building programs by promoting the use of ocean observations to ensure regional socio-economic sustainability through (i) regular repeatable training workshops conducted in exchange for annual sea days aboard PANGEA partner's ships for deployments and routine maintenance of ocean observations; (ii) in-country practical applications training of ocean data provided to large and diverse groups of regional participants, rather than a few selected individuals travelling to a workshop far away. Developing maritime Nations are empowered to effectively contribute to the Global Earth Observing System of Systems (GEOSS) by offering their often underutilized ships to deploy observational equipment provided by their PANGEA partners. This approach ensures ocean observations are viewed not only as important for science, but also for economic prosperity, and are therefore deemed a high priority for fiscal decisions. A more sustainable capacity for the region can be achieved through the increases in both near real-time in-situ ocean observational data and information as well as the more effective applications of existing and new data.

Technology innovations

5.2.14 Savings in terms of technology innovation can be made in a number of ways:

- Less expensive equipment sold by manufacturers, and providing equivalent, or better quality observations. This will be realized by enhancing the cooperation with the manufacturers through HMEI, and the RMICs.
- Design of multi-purpose platforms, which cost is shared by different communities. The governance framework under JCOMM permits to work with partner organizations on the development of such design.
- Design of moorings that are more difficult to vandalize (vandalism on ocean data buoys remains a concern). This is an issue which is being undertaken by the Data Buoy Cooperation Panel of JCOMM.
- Instruments providing measurements of higher quality, and higher time and vertical resolution, hence permitting reducing the density of the networks (recommendations to be made through the Rolling Review of Requirements). The development of Pilot Projects (e.g. high resolution SST, wave measurements) will permit to realize this.
- Instruments using new satellite data telecommunication techniques that provide higher bandwidth and are more cost-effective. The DBCP and SOT Iridium Pilot Projects are addressing this issue. More generally, the proposed international forum of users of satellite data telecommunication systems will be a mechanism to realize this.
- Instruments capable of providing the metadata as part of their data output (e.g. using SensorML), hence reducing the need for human input. The META-T Pilot Project of JCOMM has already addressed this issue, but additional work by JCOMM will be needed in order to make progress in this regard.

Standardized and interoperable data systems

5.2.15 The benefits of the WIS have been well documented[40] and will not be repeated here. The benefits of the IODE ODP are very similar for the oceanographic community and have also been documented on the project web site[41]. The Pilot Project proposed a strategy (i) to make the WIS and ODP interoperable, and (ii) to make ocean data systems interoperable with the WIS and/or ODP. Benefits from this strategy are clear and include:

- Building the WIS as a true multi-disciplinary system thanks to improved access to oceanographic datasets.

40: http://www.wmo.int/pages/prog/www/WIS/index_en.html
41: http://www.oceandataportal.org/

- ODP offering access for the oceanographic community to meteorological and other discipline data through the WIS.

5.2.16 Cost savings to both the meteorological and oceanographic communities will be realized by devoting reduced resources to data discovery (use of standardized metadata), access (interoperable systems and infrastructure), decoding and assimilation (use of common data formats leading to reduced efforts for developing decoders).

5.3 Better products and services

5.3.1 Enhancing the cooperation between NMHSs and the oceanographic centres nationally or globally will help deliver products and services that better serve the end users, and will build confidence of those end users in the quality of the services they are receiving. Applications targeted are mainly the following:

- Numerical Weather Prediction
- Marine applications including traditional marine services (e.g. the Global Maritime Distress and Safety System - GMDSS), ocean forecasting, Tsunami monitoring, coastal applications, marine climatology
- Climate monitoring, prediction, and services

5.3.2 Quality of the end products depends partly on the quality of the data that they routinely use and assimilate. Improving the observations is therefore necessary to improve products. As described below, better products and services are expected to be realized through (i) enhancing the quality of the observations, (ii) increasing the quantity of observations made available, and (iii) providing more coherent datasets through standardization.

Better quality observations for improved applications

5.3.3 The quality of the observations will be realized as following:

- Quality Management, and documentation of processes, in accordance with the WMO Quality Management Framework (QMF), and the eight Quality Management Principles[42] proposed by ISO.
- Better calibrated instruments through the use of facilities offered at the WMO-IOC RMICs.
- Better quality monitoring thanks to improved integration between *in situ* and satellite observations. Strategies described under “Integration of *in situ* and satellite observations” above are expected to enhance the quality monitoring of the *in situ* networks, permit bias correction, provide for better information about the measurement uncertainties, and remove erroneous data from data distribution to end products.
- Provision of higher temporal, and higher vertical resolution data thanks to the use of new satellite data telecommunication systems with higher bandwidth. This can be facilitated through Pilot Projects under JCOMM as well as through the proposed international forum of users of satellite data telecommunication systems.
- Better compliance to proposed standards, improved traceability to standards, better knowledge of the instrument uncertainties, and consistency/coherence of the observations thanks to routine collection of instrument/platform metadata, instrument intercomparison campaigns conducted through the RMICs, and assistance from the manufacturers, in particular through HMEI.
- Better siting of the instruments will be realized through recommendations to Members based on collection of appropriate instrument/platform metadata, and analysis of the information.

5.3.4 In addition, the activities above will permit to know the quality of the observations and better estimate the uncertainties. This will result in better knowledge of the end-product uncertainties.

42: http://www.iso.org/iso/iso9000-14000/understand/qmp.html

More observations through better access for improved applications

5.3.3 The quantity of the observations will be realized as following:

- Solidifying links between meteorological and oceanographic data centres and making more time-critical and delayed mode oceanographic datasets visible and accessible via the WIS and the ODP. The Pilot Project has already targeted a number of datasets with encouraging results but more work will be needed to achieve enhanced integration in this regard.
- Oceanographic centres and partner organizations will gain better access through WIS to meteorological data for ocean modelling and research applications (e.g. ocean-atmosphere interactions, climate data input for ocean modelling, hydrological data related to river discharges into the oceans).
- Increased temporal and vertical resolution data will be collected from observing platforms thanks to improved satellite data telecommunication.

5.3.4 It is difficult to provide estimates of the number of data that will be added to the system in real-time and delayed mode due to the actions above. At the same time, it is useful to recall the following estimates of data volumes that are targeted (most of which being already exchanged in real-time through the GTS). The goal will be to make sure all of the datasets indicated in the table below are eventually discoverable, and accessible via the WIS and/or ODP.

Observing platform type	**Units (target)**	**Status**	**Frequency**	**Availability**	**GTS**	**Estimate of ultimate data volume per year (records x bytes per record)**
Surface drifters	1250	100%	1h	Real-time	Y	11 000 000 x 256
Tropical moorings	136	83%	1h	Real-time	Y	1 200 000 x 256
OceanSITES	122	75%	<1h	Real-time and/or delayed-mode	Partly	1 000 000 x 1024
Ice buoys	440	27%	1h-3h	Real-time and/or delayed-mode	Partly	3 000 000 x 500
Tide gauges	290	68%	15min – 1h	Delayed-mode and/or real-time	Partly	10 000 000 x 256
T/S profiles from floats	3000	100%	10 days	Near real-time (24h)	Y	100 000 x 1024
VOS ships	1000[43]	100%	3h	Real-time	Y	6 000 000 x 256
VOSClim ships	250[43]	100%	3h	Real-time and delayed-mode	Y	2 000 000 x 1024
ASAP ships	21[43]	100%	12h-24h	Real-time	Y	10 000 x 1024
SOOP lines	51	66%	1h-8h	Real-time	Y	30 000 x 1024
Ocean carbon inventory lines	37	43%	1h-24h	Delayed-mode	No	300 000 x 1024

43: There is no specific target for the VOS, VOSClim, and ASAP Programmes, the number of ships indicated here is the average number of ships that are reporting daily. VOS Programme is also targeting increased automation. There are currently 500 ships equipped with AWS.

More coherent datasets through standardization for improved applications

5.3.5 WIGOS integration calls for (i) harmonizing standards between the different disciplines contributing to WMO Programmes and Co-sponsored Programmes, (ii) promoting the use of the recommended standards, and (iii) making data traceable using those standards. This, together with regular intercomparisons of the various instruments measuring the same variables will permit to produce coherent, and bias-corrected datasets. This will provide (i) better use of the data for the production of consistent quality products as well as (ii) facilitating data quality monitoring activities through feedback of better quality information from data users back to data producers in order to make corrective action on those platforms reporting erroneous or biased data.

5.3.6 The monitoring of the observing networks, and the collection of metadata about the observing platforms and the instruments will permit to identify what standards are being used, and whether those standards comply with the WIGOS recommended standards. Based on this information, it will be possible to make recommendations to platform operators on what standards to use. This will be facilitated by the publishing of appropriate manuals, guides, and publications describing the standards being used. Some harmonized standards will be promoted through ISO.

5.4 Increased visibility for Members producing ocean observations, and related products and services

5.4.1 Increased visibility for Members producing ocean observations, and related products and services are expected to be realized in the following ways:

- Outreach to the general public due to products and services of increased quality and credibility.
- Outreach to data user communities in other disciplines due to weather, climate, and water data becoming discoverable and usable by them through the WIS. Partner organizations will retain ownership and remain independent and can continue to operate parallel data systems they have put in place (while those have become interoperable with the WIS).
- Capacity Building activities modelled on the PANGEA concepts as described above will raise awareness about the use and applications of ocean data.
- The cooperation with the IOC of UNESCO and its IODE Project Office will (i) promote additional Capacity Building activities at the training centre in Ostend, Belgium, and (ii) advertise applications of ocean data through the OceanTeacher web portal[44].
- Contribution to GEOSS through provision of data to the wider community through the WIS. The WIS is the core component of GEOSS for weather, water, climate and disaster societal benefits.

5.5 Better research for future applications

5.5.1 Better research for future applications is expected to be realized in the following ways:

- Much of the benefits described in *paragraph 5.3* above regarding products and services also apply to research applications to a very large extent. Research applications will gain better access to marine meteorology and oceanographic data thanks to appropriate datasets becoming discoverable via the WIS and the ODP. Data of known quality will be more coherent, and traceable to standards.
- Observing networks that better meet the requirements of physical oceanography research, climate research, ocean mesoscale forecasting will eventually facilitate the development of operational oceanography nationally and globally for delivery of products and services that better serve the end-users.
- Improved research, and the knowledge acquired will permit further optimization of the observing networks in a more cost-effective way, including for operational applications.

44: http://www.oceanteacher.org/

- Improved data assimilation techniques will allow better exploitation of observations in Numerical Weather Predictions (NWPs), and ocean mesoscale forecasting models in an integrated manner. This will also permit observing network optimization.

6) Strengths and weaknesses in the management of the ocean observing systems

6.1 The second meeting of the joint Steering Group (Ostend, Belgium, October 2009) reviewed the strengths and weaknesses of the current governance framework in the management of the ocean observing systems as detailed in ***Annex VIII***. It agreed that many actions have already been proposed to address weaknesses as part of the Pilot Project Implementation Plan. In addition, based on this review, the meeting agreed that:

- The type of governance existing with JCOMM should be preserved;
- JCOMMOPS, which is providing support for the implementation, and monitoring of marine observing networks on a day to day basis should be strengthened;
- A reviewing of the WMO-IOC Technical Publications should be conducted to address a number of issues including Quality Control, the collection of instrument/platform metadata, instrument standards and intercomparisons, and satellite data telecommunication issues;
- It would be beneficial to promote establishing an international forum of users of satellite data telecommunication systems to address tariff negotiations, user requirements, and making recommendations on deficiencies and gaps related to the use of such systems;
- A communication strategy should be promoted to address (i) integration of *in situ* and satellite observations (use of *in situ* data for the calibration and validation of satellite products, merged *in situ*/satellite level 2 products as part of virtual constellations, bias correction, quality information feedback to observing platform operators), (ii) benefits & rationale for data exchange, (iii) benefits and rationale for collection and sharing of instrument/platform metadata.

7) Impact of the marine observing systems integration, and use of recommended standards on the operations of NMHSs, and NODCs

7.1 Instrument practices

7.1.1 To comply with WIGOS requirements, those in charge of deploying and operating observing platforms at sea will have to do the following in addition to their traditional activities in terms of instrument practices:

- Purchase observing platforms and instruments that comply with the standards and practices recommended by WMO and/or IOC as appropriate. Enhanced cooperation with the manufacturers, through HMEI, will make sure that the manufacturers can provide such equipment.
- Calibrate instruments according to the recommended procedures. Assistance from WMO-IOC RMICs can be obtained if needed.
- When applicable, be familiar with, and use the recommended cost-effective practices regarding satellite data telecommunication.
- Routinely record the instrument/platform metadata and make them available to the wider community using recommended standards and protocols.
- Regularly participate in marine instrument intercomparisons campaigns by providing instruments, RMIC facilities, and/or expertise.
- Provide feedback and input to the JCOMM Expert Teams and Panels regarding instrument standards.
- Where possible, offer RMIC facilities to support developing countries in the regions.

7.2 Data exchange

7.2.1 To comply with WIGOS and WIS requirements, those in charge of collecting and distributing ocean data will have to do the following in addition to their traditional activities in terms

of data exchange:

- Comply with WMO data policy (Res. 40[17] – Cg-XII) and/or IOC oceanographic data exchange policy (Resolution IOC-XXII-6[45]).
- Distribute time-critical data through the GTS using recommended WMO formats.
- Make the data discoverable through the WIS and/or the ODP by (i) using appropriate ISO 19115 profiles[46], and (ii) make the data accessible in real-time and delayed mode through data servers. Data providers will need to accept and implement a set of agreed interoperable arrangements, including the technical specifications and web-services, for the integration and shared use of the metadata, data and products. Documentation on ODP can be found on the ODP web site[47]. Alternatively, in case of IT security concerns, the ODP lLight Data Provider (LDP) facility might be used as it does not require software installation. In case of the WIS, the metadata and data can be made available through either of the following WIS infrastructure elements: a "National Centre" (NC) or a "Data Collection or Production Centres" (DCPC). Those centres providing data through WIS will have to comply with WIS compliance specifications of Global Information System Centre (GISC), DCPC, and NC[48].

7.3 Quality management

7.3.1 To comply with WIGOS requirements, those in charge of managing ocean observing networks will have to do the following in addition to their traditional activities in terms of quality management:

- Comply with standards recommended for instrument practices, quality control, and data exchange (impact detailed in *paragraph 7.1* and *7.2* above).
- Improve data timeliness for time critical data, and minimize duplicates.
- Ensure that the Recommendation 8 (JCOMM-III) — Implementation of Quality Management Systems for Met-Ocean Data, Products and Services by Members/Member States is followed (see *paragraph 4, deliverable 3* above for details). ISO 9001 certification is not mandatory but it is recommended that the processes involved in the collection, distribution, and archival of ocean data are documented.
- Contribute to the JCOMM/IODE Ocean Data Standards[49] process in accordance with Recommendation 4 (JCOMM-III) — Development of Data Management Standards (see *paragraph 4, deliverable 3* above for details).

8) Lessons learned

8.1 Many lessons learned from this Pilot Project have fed into the work of the Sub-Group of the Executive Council Working Group on WIGOS and WIS, and details can be found in a preparatory document for the Second Session of the Sub-Group[50] (Geneva, Switzerland, 19-23 October 2009). Only the most important lessons learned relevant to this Pilot Project are detailed below.

8.2 The Pilot Project realized substantial progress on many issues that would have been slower to achieve or would not have been achieved at all otherwise. The achievements are detailed in *paragraph 4*. Due to these achievements, the Pilot Project has prepared the legacy recommendations as detailed in *paragraph 9* below.

8.3 The success of the Pilot Project has been due to a number of factors:

45: http://www.iode.org/index.php?option=com_content&task=view&id=51&Itemid=95

46: ISO 19115 states that individual communities may develop "community profiles" of the international standard. . ISO 19115 profiles that may be used in the context of WIGOS and ocean observations are: (i) the WMO Core Profile, (ii) the Marine Community Profile (MCP) used with the Ocean Data Portal (ODP) and interoperable with the WIS, and (iii) the Common Data Index (CDI) used with SeaDataNet and interoperable with the ODP.

47: http://www.oceandataportal.org

48: http://www.wmo.int/pages/prog/www/WIS/ref_docs_en.html

49: http://www.oceandatastandards.org

50: http://www.wmo.int/pages/prog/www/WIGOS-WIS/meetings/WIGOS-2_Geneva2009/Doc-4-3.doc

- JCOMM, which is a joint Technical Commission between WMO and IOC, provided the appropriate governance and mechanisms to engage with all partners having potential interest in the development of the Pilot Project.
- The IOC provided excellent cooperation, mainly through its International Oceanographic Data and Information Exchange (IODE) Committee. Good working relationships were established between the WMO and IOC Secretariats which built trust and shared the work. Good communication drew attention to the rationale for WIGOS, and address concerns. By establishing a joint Steering Group for the Pilot Project, IOC had ownership upfront and could influence its development.
- The benefits of the Pilot Project were well understood by all partners and the members of the joint Steering Group, and there was confidence that the synergies proposed between the WIS and the IODE ODP would facilitate better access to both oceanographic and meteorological data.
- Increased resources provided by both WMO and IOC Secretariats in support of the Pilot Project built synergies between many Expert Teams, Panels, and groups under JCOMM, IODE, CIMO, and CBS, which lead to improved cooperation.
- Ability to build on past experience with regard to the End to End (E2E) technology developed jointly between IODE and JCOMM through the Expert Team on Data Management Practices (ETDMP).

9) Legacy recommendations

9.1 The legacy recommendations below, agreed by the joint Steering Group for the IODE Ocean Data Portal and the JCOMM Pilot Project for WIGOS, are based on the Pilot Project achievements, identified pending issues, and lessons learned:

(1) The type of governance existing between WMO and IOC through JCOMM should be preserved, and the JCOMM activities related to marine meteorology and other appropriate oceanographic observations should play an active role in the WIGOS implementation phase, and eventually become part of WIGOS once it becomes operational.

(2) WMO and IOC Publications should be regularly reviewed based on the proposed methodology (***Annex VII***). This should be done by addressing harmonization of standards related to (i) Quality Control, (ii) the collection of instrument/platform metadata, (iii) instrument practices and intercomparisons, and (iv) satellite data telecommunication issues.

(3) WMO and IOC should act pro-actively to facilitate the collection, distribution (including in real-time, and through dedicated servers), and discovery of instrument/platform metadata. In particular, the depth of the SST (Sea Surface Temperature) and SSS (Sea Surface Salinity) measurements should be reported as accurately as possible for use in satellite products as appropriate.

(4) JCOMM should develop guidelines for marine instrument intercomparisons, publish then as JCOMM Technical Report, and provide input to the CIMO Guide accordingly.

(5) JCOMM should further develop the network of WMO-IOC Regional Marine Instrument Centres (RMIC) in all regions, promote their activities, conduct training workshops, and instrument intercomparisons.

(6) The cooperation with the manufacturers should be strengthened through HMEI.

(7) IODE should continue the development of the IODE ODP and interconnect with the WIS as a WIS DCPC.

(8) IODE should seek interoperability of the ODP with other (non IODE) ocean related data centres.

(9) JCOMM should work to increase the amount of oceanographic and marine meteorological data provided by data centres to the ODP and WIS.

(10) WMO and IOC should promote the IODE/JCOMM Standards process, seek harmonization of standards between WMO and IOC, and make sure that processes are documented.

(11) JCOMM should promote quality management in compliance with the WMO Quality Management Framework (QMF).

(12) WMO and IOC should promote establishment of an international forum of users of satellite data telecommunication systems.

(13) JCOMMOPS, which is providing support for the implementation, and monitoring of marine observing networks on a day to day basis should be strengthened.

(14) The JCOMM PANGEA concept should be supported to enhance partnership between developed and developing countries with regard to data use and implementation of ocean observing networks.

(15) JCOMM should communicate information – based on this project report – about the benefits to various communities of the integration or marine and other appropriate oceanographic observations into WIGOS.

(16) JCOMM should be promoting pilot activities to evaluate how *in situ* and satellite based observing systems complement each other; in the view to make recommendations for the optimization of the *in situ* networks.

9.2 Proposed future workplan, responsibilities, and costing based on the Pilot Project legacy recommendations are provided in ***Annex X***. About $95k would be required each year to support the proposed activities, and an additional $10k to recruit a consultant who would compile a document on guidelines for marine instrument intercomparisons.

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ANNEX I

PROJECT SUMMARY

THE JCOMM PILOT PROJECT FOR WIGOS (OUTLINE)

"Integration of marine meteorological and other appropriate oceanographic observations into the WMO Integrated Global Observing Systems"

Project Name	**JCOMM Pilot Project for WIGOS**
Acronym	N/A
Project Type	Pilot
Project Status	The pilot has defined a detailed implementation plan at the meeting of the joint Steering group for the IODE Ocean Data Portal (ODP) and the JCOMM Pilot Project for WIGOS (Geneva, 18-19 September 2008). The Project plan was defined at the *ad hoc* planning meeting for the JCOMM Pilot Project for WIGOS (Ostend, Belgium, 29 March 2008). The Implementation Plan was reviewed at the second meeting of the joint Steering Group (Ostend, Belgium, 15-16 October 2009). Mechanisms have been defined for reviewing WMO and IOC Publications, as well as and other appropriate JCOMM documentation. Specific review was conducted regarding the marine chapter of the CIMO Guide (WMO No. 8). A standards process for developing ocean data standards was established in cooperation with the IOC of UNESCO, and one particular standard has been proposed, reviewed, adopted and published; two other standards have been submitted, and are still under review while there is plan for submitting a fourth one. The development of a JCOMM Catalogue of Best Practices and Standards has been made with the help from a consultant funded by IOC. Thirteen key potential datasets have been identified (see below) for becoming interoperable with the ODP and the WIS; the partners holding these datasets have been approached and some already replied favorably. Three data management workshops were held in March 2009 in Obninsk, Russian Federation, in Seoul, Republic of Korea in September 2009, and in Istanbul, Turkey in December 2009 to address interoperability between ocean data systems in those regions and the ODP. The Obninsk workshop also addressed interoperability between the ODP and the WIS. The Pilot Project proposed establishing Regional Marine Instrument Centres (RMIC); JCOMM-III approved Terms of Reference for the RMICs, and three centres offered to act as such for the RA-I (Morocco), RA-II (China), RA-IV (USA). A successful workshop was organized in April 2010 at the RMIC for RA-IV to prove concept. The Pilot Project has engaged with the HMEI. The Pilot Project ended in December 2010. A Project Report has been finalized summarizing the achievements of the Pilot Project, pending issues, lessons learned, benefits and impacts on Members/Member States regarding the integration of marine meteorological and other appropriate oceanographic observations into WIGOS, as well as Pilot Project legacy recommendations.
Project Overview	Development of the Pilot Project was coordinated by a Steering Group, providing liaison with appropriate WMO Programmes and Technical Commissions, the WMO EC-WG on WIGOS-WIS (and its sub group), and the International Oceanographic Data and Information Exchange (IODE) of IOC. The Steering Group was responsible for producing the Pilot Project Plan and promoting the continued development and implementation of a system of interoperable systems that provides consistent, documented data and information of known quality from a sustained and coordinated global ocean observing system. Three components have been proposed in the development

	of the Pilot Project: (i) promote and document instrument best practices and related standards, (ii) build marine data systems that are interoperable with WIS, and (ii) promote quality management and standards. The Project recognized and respected the ownership of all partner organizations as well as the WMO and IOC data policies.
Project Aims	Enable the integration of marine meteorological and other appropriate oceanographic observations (*in situ*, surface marine and satellite), real time and delayed mode data and products (e.g. models) within the oceanographic marine community. The Pilot Project also considered assembled *in situ* fields, biochemistry, model outputs, surface and underwater marine climatologies and measurements. The Pilot Project aimed at making the appropriate identified datasets interoperable with the wider WMO and IOC communities. It developed and agreed on consistent standards to be used across the community. It l increased accessibility of specific datasets; enhanced integration of standards and best practices and their publication in appropriate WMO and IOC Publications; as well as set guidelines regarding Capacity Building and training programme.
Partners/Participants	• International organizations co-sponsoring GOOS: WMO, IOC, UNEP and ICSU • WMO and IOC Technical Commissions and Programmes (e.g. CIMO, CBS, GOOS and IODE) • WMO Information Systems and its Expert Teams, ICT-WIS • Ocean Data Portal and ETDMP Task Team on ODP/JCOMM Pilot Project WIGOS • ETDMP Task Team on standards process • IODE Ocean Data and Information Networks (ODINs) • JCOMM E2E prototype (Russian Federation NODC, Obninsk) • Instrument centres • Observing Panels • Association of Hydro-Meteorological Equipment Industry (HMEI) • Partners hosting relevant datasets (*in situ*, space based ocean observations datasets, as well as products) o Integrated datasets ▪ SeaDataNet; ▪ The Global Temperature and Salinity Profile Programme (GTSPP); ▪ The Australian Ocean Data Network (AODN) o Data from specific networks ▪ Argo profiling float data; ▪ RNODC/DB (drifter data); ▪ XBT data; ▪ Instrument / platform metadata (META-T, ODASMS); o Remote sensing ▪ The Virtual constellation for Ocean Surface Vector winds; ▪ The Group for High Resolution SST (GHRSST); ▪ Surface based remote sensing (e.g. HR Radar); o Climatologies ▪ World Ocean Atlas (WOA) ▪ Marine Climatological Summaries, e.g. Delayed-mode VOS data collected by the Global Collecting Centres (GCCs) ▪ Blended quality climatology products such as the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) o Metadata about the platforms/instruments (e.g. META-T) • Additional participants and partners to be discussed and defined

Funding Source(s)	The project, to the maximum extent possible, made use of the expertise provided through the working structure of JCOMM, IODE, and its WIGOS partners. Additional support was required through the WMO budget and/or WIGOS-WIS Trust Fund. Implementation costs are met by the Members.
Project Timescale	2007 – Mid-2008: Establishment of the Pilot Project and proposal for its Steering Group Terms of Reference and Membership; Sept 2008: First meeting of the Pilot Project joint Steering Group; Adoption of the project implementation plan Nov. 2008: Reporting to the SG of the WMO EC WG WIGOS-WIS; End 2008 – 2009: discussions with partner observing programmes (DBCP, SOT, GLOSS, Argo, etc.) and organizations (IOC and IODE); Mar. 2008: Presentation of the Pilot Project at TECO-WIGOS May 2009: Reporting to the WMO EC WG WIGOS-WIS; Oct. 2009: Second meeting of the Pilot Project joint Steering Group; updating of the implementation plan; proposal to establish WMO-IOC Regional Marine Instrument Centres (RMIC) and to organize a workshop to prove concept; methodology proposed for reviewing WMO and IOC Publications regarding instrument practices; Oct. 2009: Reporting to the Sub-Group of the EC WG on WIGOS and WIS; Nov. 2009: Reporting to the third Session of JCOMM; 2010-2011: Implement the projects; End 2010: End of the Pilot Project and Project Report with legacy recommendations finalized.
Expected Key Deliverables	The Pilot Project addressed Result Based Management of WMO and IOC (i.e. it linked its deliverables to the Expected Results). The Pilot Project had the following deliverables: (i) Project Plan; (ii) Implementation Plan; (iii) Project Report with legacy recommendations, to be used by the directors of NMHS and Oceanographic institutes to make the case at the national level for engaging in the necessary developments, funded nationally, to meet the requirements for the integration of marine meteorological and other appropriate oceanographic observations into WIGOS; In addition, key concrete deliverables are: (i) Documenting and integrating instrument best practices and related standards among the marine meteorological and oceanographic communities; (ii) Build marine and oceanographic data systems that are interoperable with the WMO Information System (WIS) in close cooperation with the IOC ocean community; (iii) Promote quality management and standards and establishing compliance with the WMO Quality Management Framework (QMF); (iv) Participation in the CBS Rolling Review of Requirements (RRR) process and provide input to the WMO Database (instrument performances and requirements). This lead to some practical achievements listed in the summary below.
Project Links	http://www.wmo.int/pages/prog/www/wigos/marine_pp.html http://www.oceandataportal.org http://www.oceandatastandards.org http://bestpractice.iode.org

Project Summary	The Pilot Project was an interdisciplinary exercise seeking the integration of *in situ* and space based observing systems. The Pilot Project permitted to prove concept and pave the way for the integration of marine meteorological and other appropriate oceanographic observations into WIGOS. Integration efforts will be implemented and sustained by the WMO and IOC Members through JCOMM in order to make appropriate ocean datasets available in real-time and delayed mode to WMO and IOC applications through interoperability arrangements with the WIS and the IODE Ocean Data Portal (ODP). The datasets will be produced according to agreed upon instrument, data management, and quality management standards and the quality control procedures documented according to QMS principles. This integration will enhance the coherence and consistency of the datasets, the traceability of ocean data to international standards, and the availability of relevant instrument/platform metadata. More timely and better quality data will be expected while duplicates will be minimized. **-1- Documenting and integrating best practices and standards**. The goal is to define and agree on common standards between the meteorological (WMO) and oceanographic (IOC) communities for instruments and methods of observation as well as subsequent organization and handling of the data and information to serve consistent and better quality data to both the broad user and modeling communities. **-2- Making marine data systems and WIS interoperable**. The goal is to provide access to marine meteorological and oceanographic data and information to serve a number of applications, including climate. This shall be done in an integrated way via the WIS and thereby facilitating access to well documented and standardized data. The Pilot Project addressed the development of interoperability between the WMO and IOC communities at both the data discovery (metadata) and data level (compatible formats). **-3- Quality Management**. The goal is to coordinate the development of cost-effective Quality Management Systems by Members and to propose practical solutions or examples. At different steps of the data production line, it is expected that improved quality management will result in better, timelier data, minimized duplication, and an operational data delivery system. This will be achieved through the compilation of regulatory documentation in a way consistent with the eight Quality Management Principles developed under ISO/TC176/SC2/WG15 (User/customers focus, Leadership, Involvement of people, Process approach, System approach to management, Continual improvements, Factual approach for decision making and, Mutually beneficial supplier relationships). Practical achievements of the Pilot Project include: - Establishment of a network of Regional Marine Instrument Centres in USA, China, and Morocco; - Review of marine chapters of WMO Publication No. 8 and 471; - Enhanced links with the Association of Hydro-Meteorological Equipment Industry (HMEI) and the manufacturers of ocean instruments; - Connection of key ocean datasets to the IODE Ocean Data Portal and/or the WIS; - Interoperability between the ODP and the WMO Information System (WIS); - Establishment of a standards process for ocean data management and submission of several standards through that process; - Organization of several training courses on instruments and data management.
	15/11/2010

Date of Last Update	
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ANNEX II

TERMS OF REFERENCE, AND MEMBERSHIP OF THE JOINT STEERING GROUP FOR THE IODE OCEAN DATA PORTAL AND THE JCOMM PILOT PROJECT FOR WIGOS

1) Terms of Reference

The development of the JCOMM Pilot Project for WIGOS and the IODE Ocean Data Portal will be coordinated by a joint Steering Group, providing liaison with appropriate WMO and IOC Programmes and subsidiary bodies. The Steering Group will be responsible for:

a) Producing the respective Pilot Project Plans in a coherent and consistent way;

b) Liaising with the EC-WG/WIGOS-WIS Sub-Group on WIGOS (SG-WIGOS) regarding the development of the Pilot Project and refinement of the WIGOS Concept of Operations (CONOPS);

c) Liaising with the IODE Officers regarding the development of the ODP;

d) Promoting the continued development and implementation of a system that provides data and information from a sustained and coordinated global ocean observing system;

e) Coordinating and promoting the development, documentation, and integration of best practices for the different components of the marine observing and data systems;

f) Coordinating and promoting the development of interoperability arrangements between different components of the marine data system, and the provision of the real-time and delayed mode observational data through the WIS and ODP;

g) Coordinating and promoting the development, documentation, and integration of QMS at the required levels of the data production line from marine observations to the delivery of data and products;

h) Coordinate its activities with the other WIGOS Pilot Projects as well as the WIGOS Demonstration Projects;

i) Seeking resources to be committed to the Pilot Project; and

j) Guiding the implementation of the Project Plan and working with the WMO and IOC Secretariats to facilitate its implementation.

The Steering Group will report to the WMO EC-WG/WIGOS-WIS Sub-Group on WIGOS (SG-WIGOS) and to the IOC International Oceanographic Data and Information Exchange (IODE) Committee. Reporting will also be provided to the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM).

2) Membership (November 2009)

- IODE Representative (Co-chairperson) - *Mr Greg Reed (Australia);*
- CIMO Representative (Co-chairperson) – *Dr Jitze van der Meulen (Netherlands, replacing Mr Rainer Dombrowsky – USA – as co-chairperson of the Pilot Project, and retired in mid-2009);*
- JCOMM DMPA Co-ordinator - *Mr Robert Keeley (Canada);*
- JCOMM OPA Representative - *Ms Candyce Clark (USA);*

- JCOMM ET-DMP Chairperson - *Mr Nikolay Mikhaylov (Russian Federation);*
- WIS Representative - *Mr Eliot Christian (WMO Secretariat);*
- US-IOOS Representative - *Dr Jack Harlan (USA);*
- US NODC Representative – Dr *Kenneth Casey (USA); and*
- MCSS and GCC Representative - *Ms Nicola Scot (UK);*
- JCOMM instrument expert – *Dr chung-Chu Teng (USA).*

3) Secretariat provided by

- WMO Secretariat – Mr Etienne Charpentier
- IOC Secretariat – Mr Peter Pissierssens

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ANNEX III

PILOT PROJECT DELIVERABLES

(Excerpt from the Overarching Implementation Plan for the Ocean Data Portal (ODP) and the WIGOS Pilot Project for the IODE and JCOMM[1])

DELIVERABLE 1: DOCUMENT AND INTEGRATE INSTRUMENT BEST PRACTICES AND RELATED STANDARDS

The two domains of marine meteorology and oceanography have different histories that have resulted in different practices. For marine meteorology, there is a long history of working within the framework of the WMO and the various regulations and observing practices that have been established. In contrast, oceanographic observations are more recent and most originate from a research environment. As a result, new methods and procedures are frequently being tested and this results in less standardization of practice, though best practices are evolving.

This Pilot Project is focused on the practices that impact data collection, processing, archiving and dissemination. The standards and practices used in observing the atmosphere and ocean need to be well documented and ensure that sufficient detail accompanies observations so that a user can interpret the measurements correctly.

Information on Meteorological Parameters:

The practices used for making meteorological observations have been standardized by WMO through its Commission for Instruments and Methods of Observation (CIMO). CIMO is responsible for the *WMO Guide to Meteorological Instruments and Methods of Observations* (WMO Publication No. 8 - *CIMO Guide*), which includes a marine chapter that describes these practices and standards. This material needs to be reviewed during the course of this Pilot Project to update and / or add content that reflects present operations of marine meteorological practices. [Action 1.1]

Information from the JCOMM Observations Programme Area (OPA) Panels:

Instrument best practices, calibration procedures, operating / implementation / deployment procedures and guides, quality control procedures and / or guidelines (delayed-mode, real-time, automatic, or manual), data processing techniques, and formats (e.g., data collection formats) have been developed over the years by the different marine observing systems whose implementation is coordinated through the JCOMM Observations Programme Area (OPA) and the predecessors of JCOMM, i.e., the WMO Commission for Marine Meteorology (CMM), and the WMO-IOC Integrated Global Ocean Services System (IGOSS). The OPA includes the Data Buoy Co-operation Panel (DBCP), the Global Sea Level Observing System (GLOSS), the Ship Observations Team (SOT), and associated groups such as the Ocean Sustained Interdisciplinary Timeseries Environment observation System (OceanSITES), the Argo Steering Group (AST), and the IOC International Ocean Carbon Coordination Project (IOCCP).

The documentation produced is being maintained by these Panels and there is benefit in reviewing the relevant information on instrumentation best practices and standards, addressing integration issues, i.e. identifying compatibilities, avoiding duplication of information, proposing higher levels of standards, including joint WMO-ISO standards. Documentation should be updated accordingly, higher level standards proposed and integrated into relevant parts of the appropriate WMO and / or IOC Manuals and Guides, or at least cross-reference between the various documentation should be included as appropriate. The review of such documentation should begin as part of the development of the *JCOMM Catalogue of Best Practices and Standards*.

1: http://www.wmo.int/pages/prog/www/wigos/documents/Impl_Plan_JCOMM.pdf

[Action 1.2]

Documenting Instrument Best Practices:

As standards for instruments and methods of observation are adopted, they will be submitted for inclusion in the marine chapter of the *CIMO Guide* (surface marine meteorological measurements) and other appropriate IOC Manuals and guides (sub-surface oceanographic measurements). An editor from the Pilot Project will work in collaboration with the Rapporteur on the *CIMO Guide* to preparing material for inclusion.
[Action 1.3]

Instrumentation Centres:

The WIGOS Concept of Operations (CONOPS) recommended that all WIGOS observational data and metadata and processed observational products should adhere to WIGOS standards for instruments and methods of observation. To achieve this, a key element is the promotion of instrument centres dedicated to marine and other appropriate oceanographic instruments. Such Centres would be essential for monitoring instrument performance, calibration procedures, providing assistance with regard to intercomparisons, as well as providing for appropriate training facilities that would complement what the manufacturers are already providing. In addition to instrument centre staff, invited ocean experts and instrument manufacturers would be invited to participate in such instrument training.

Currently there is only limited experience in oceanography for conducting formal regional or global instrument intercomparisons. Indeed, the recent revisiting of the XBT fall rate question underlines the importance of a formal mechanism to carry out these studies. So, too, is the experience in the deployment of Argo floats where it is now encouraged to carry out an initial test dive and surfacing coincident with a CTD cast to provide an initial intercomparison.

It is generally accepted that systematic intercomparisons of new with legacy instruments is needed. However, operating such intercomparisons at sea and in a variety of ocean areas and conditions would seem to be a greater challenge than normally associated with land-based meteorological instrumentation centres. CIMO has experience with meteorological instrument centres and climate instrument centres and collaboration with such experts to translate the more usual, land-based testing to ocean-based work would be valuable. The ad hoc planning meeting (Ostend, 29 March 2008) recommended that the OPA nominate someone to liaise with CIMO on instrument and best practices matters. Since the meeting, Dr Chung-Chu Teng, NOAA National Data Buoy Centre (NDBC) has been nominated by the JCOMM OPA Coordinator. Dr Teng will be invited to begin this dialogue with CIMO, and liaise with appropriate OPA experts, such as the Chairperson of the Ship of Opportunity Programme Implementation Panel (SOOPIP) and the DBCP.

Depending on the outcome of the discussions with CIMO, the Pilot Project may have to develop and propose Terms of Reference (ToR) for JCOMM Instrument Centres, as well as provide guidelines regarding exactly what would be involved in the operations of these instrument centres, e.g. providing facilities for training and organizing training events, providing facilities for the calibration and maintenance of marine instruments, holding high level equipment for the calibration of instruments, seeking ISO standards - through the IODE/JCOMM standards process - for such high-level calibration equipment, etc.

The Pilot Project would also propose strategies for addressing the costs for establishing and operating JCOMM Instrument Centres. This will require developing a proposal for an agreed upon host supported operation based on in kind contributions and the proposal of accepted mechanisms for funding additional activities going beyond a typical operating budget.
[Action 1.4]

Platform / Instrument Metadata:

The WIGOS CONOPS recommends that all WIGOS observational data and metadata (including platform / instrument metadata and discovery metadata) should be exchanged via WIS using agreed upon data and metadata representation forms and formats. Within JCOMM DMPA, there is the Water Temperature platform / instrument Metadata (META-T) Project. One of the META-T's objectives is the consolidation of instrument and other metadata to describe sea temperature measurements. There are two centres contributing infrastructure to this project, one in the United States and the other in China. The ODP-WIGOS Pilot Project for IODE and JCOMM should consider how to include this work, as well as propose a strategy for including variables other than Sea Surface Temperature and water temperature profiles in the platform / instrument metadata collection, distribution, and archiving system being developed.

Within the Voluntary Observing Ship (VOS) scheme and the VOS Climate Project (VOSClim) there are also platform / instrument metadata being assembled concerning, among other information, the siting of meteorological instruments on voluntary observing ships as well as information on air flow patterns around ship's superstructures. Such valuable information can assist in the interpretation of measurements. Just as for the META-T, these metadata should be considered for inclusion in the ODP-WIGOS Pilot Project for IODE and JCOMM.
[Action 1.5, 1.6]

Cooperation with the manufacturers

The Ostend Meeting noted the co-operation established by CIMO with the Association of Hydro-Meteorological Equipment Industry (HMEI) in terms of evaluating instrument performance and their documentation, as well as their assistance in capacity building activities. In this regard, the WMO Secretariat was asked to approach HMEI to seek their participation in the ODP-WIGOS Pilot Project for IODE and JCOMM. Early dialogue with the HMEI concluded that it has been demonstrated that HMEI can efficiently act as a relay between the meteorological instrument manufacturers and the meteorological observing community. However, with respect to marine instrument manufacturers and the marine observing community, beneficial links have already been established between them through direct contact, including manufacturers being invited to JCOMM meetings, as appropriate. Therefore, the marine instrument manufacturers do not necessarily feel the need for their participation in HMEI. At the same time, not all manufacturers attend the JCOMM meetings when invited, and when they do, they naturally tend to represent the interests of their particular company rather than those of the manufacturers as a whole. To address this issue several strategies are possible:

(a) formally recognizing the role that HMEI could play in representing the marine instrument manufacturers with the WMO and IOC through JCOMM;

(b) WMO and IOC informing by means of formal letters the manufacturers of the role they will be invited to play with both Organizations, including JCOMM Expert Teams and Panels;

(c) discouraging direct participation of manufactures at JCOMM meetings except when formally representing HMEI; and

(d) encouraging participation of HMEI member manufacturers for specific activities such as pilot projects, technology development, instrument evaluation, and intercomparisons.

In terms of capacity-building activities, HMEI members could provide assistance to developing countries by participating and collaborating with the WMO and IOC in conducting training workshops on instrument use, instrumental calibration and testing, communication and coding training. The HMEI encourages the development and possible fabrication of instruments in developing countries. The worldwide traceability of measurements to SI and development of instrument standards are also aided by HMEI involvement and participation within ISO standard setting teams.

[Action 1.7]

Actions:

1.1 Review the marine chapter of the CIMO Guide. Provide updates and additions on meteorological instruments and methods of observation as necessary.

1.2 Assemble reference material on instrument best practices and standards available from the JCOMM OPA Panels and associated observing programmes for inclusion in the JCOMM catalogue of best practices and standards.

1.3 As standards are adopted, editors from the Pilot Project and CIMO will need to work together to prepare the material for inclusion in the marine chapter of the *CIMO Guide*.

1.4 Dr Teng will discuss with CIMO about ocean instrument centres, and liaise with appropriate OPA experts, such as the Chairperson of the SOOPIP, the DBCP and other appropriate Panels. The Project may need to propose and agree on Terms of Reference (ToR) for the JCOMM Instrument Centres, and develop guidelines for running them. It should propose guidelines regarding the costs involved for setting up and running such centres.

1.5 The Pilot Project should determine if and how the information assembled by the JCOMM META-T Project can be included, as well as propose a strategy for including other variables than SST and water temperature profiles in the platform / instrument metadata collection, distribution, and archiving system being developed.

1.6 The Pilot Project should determine if and how the information assembled by the VOS and VOSClim Projects can be included.

1.7 The WMO and IOC Secretariats to write to the marine instrument manufacturers and invite them to be represented through the Association of Hydro-Meteorological Equipment Industry (HMEI), to consider organizing training workshops and developing cooperation with the Pilot Project.

DELIVERABLE 2: BUILD MARINE DATA SYSTEMS THAT ARE INTEROPERABLE WITH THE WIS

Access objectives of this Pilot Project will be achieved through improved interoperability between oceanographic and meteorological communities. The Ostend Meeting itemized a number of potential organizations that could be approached to contribute datasets they support to the Pilot Project. The lists were qualified by potential, meaning those that appeared to be available, and tentatively committed, meaning those that were prepared to initiate discussions to assess the resource implications of their participation. These were:

Potential:

- *In situ* datasets from the JCOMM Observations Programme Area such as:
    - Profiling floats (Argo);
    - Deep ocean time-series reference stations (OceanSITES);
    - Tropical moorings (TAO);
    - Drifters (DBCP);

- Ship-based observations in the SOT (ASAP, VOS, XBTs);
- Tide gauges (GLOSS);
- Water temperature and salinity profiles (GTSPP);
- Surface underway data (GOSUD); and
- Ocean carbon (IOCCP), etc.

- Satellite products and analysis, and merged *in situ* / satellite products (e.g., GHRSST);
- Model output fields (e.g., GODAE);
- Metadata about the platforms / instruments (e.g., META-T);
- Integrated data systems (e.g., SeaDataNet, DMAC);
- ODINs (Demonstration projects, because some of them had E2E training course already they could provide datasets and get access to the WIS);
- Fast delivery sea level data (University of Hawaii Sea Level Center);
  - World Ocean Database;
- Instrument Centres; and
- Ocean current data from VOS.

<u>Tentatively committed:</u>

- US NODC (Mr Terry Tielking):
  - World Ocean Atlas; and
  - US NODC GTSPP (Mr Charles Sun)
- Surface currents from HF radar (Dr Jack Harlan);
- Russian Federation NODC (Mr Nikolay Mikhaylov):
  - End-To-End prototype technology (Russian Federation);
- GTS operational database, marine-surface climatology (air T, SST, sub-sal, oxygen);
- Canada, ISDM (Mr Robert Keeley):
  - Upper-ocean T & S gridded *in situ* fields; and
  - Ocean currents derived from surface drifters

Permanent Service for Mean Sea Level (PSMSL) (Mrs Lesley Rickards);

- Marine Climatological Summaries and Global Collecting Centres (GCCs) (UK Met Office or DWD via Virtual GISC) (Ms Nicola Scott); and

- Blended quality climatology products (e.g., ICOADS) (Mr Scott Woodruff).

Since the Ostend meeting, strong interest has been expressed by the GHRSST-PP (GODAE High Resolution Sea Surface Temperature Pilot Project) to be included in this Pilot Project. The GHRSST (renamed to the Group for High Resolution SST in 2009) agreed that its participation in this Pilot Project would be an effective mechanism for the GHRSST to deliver its information to users. The most likely mechanism for GHRSST to contribute data to the Pilot Project is through the US NODC, which maintains the GHRSST Long Term Stewardship and Reanalysis Facility (LTSRF). The LTSRF at the US NODC maintains the entire collection of GHRSST datasets, beginning 30 days after observation. The collection includes 30-40 individual data streams at present, each of which could be registered by the US NODC into the ODP Lightweight Data Provider.

Mr David Thomas (WIS Programme Manager, WMO Secretariat) attended a SeaDataNet meeting in April 2008, and presented the Pilot Project. SeaDataNet was very interested in WIS, especially the linking of search capabilities through the search standard ISO 23950 and the metadata standard ISO 19115. With SeaDataNet's close link to INSPIRE and focus on interoperability, there are many similarities between the objectives of WIS and those of the SeaDataNet. There are also strong opportunities for technical discussions with SeaDataNet developers, including ideas on security and metadata.

Infrastructure:

a) End-to-End technology

The Russian NODC has been leading the way in the development of a prototype linking the WIS with their End-to-End system (E2E). They have constructed software that allows their centre to operate as a DCPC. This requires the installation of certain software on a server that is exposed to the Internet. Any other centre taking part in the Pilot Project that wants to function as a DCPC will need to do the same installation.

A contributor can play the role of a data provider to the E2E system. This requires the installation of a smaller set of software than for a DCPC. Flexibility built into the operating software provides access to flat files, relational databases and data within the netCDF structure.

To provide access to data, it is necessary to provide discovery metadata in the WMO core profile of the ISO 19115 standard. Metadata in another form may be transformed into this structure, or if the metadata do not exist, they will need to be created. Tools within the E2E software can facilitate this process.

Extensive documentation has been prepared to describe the operation of the software both at a high-level and at a more detailed level. The documentation is currently under review and should be available in the near future. Once completed it will be made widely available to help potential data and information contributors understand what they must do to be contributors to the Pilot Project.

b) Specific developments by candidate National Centres (NC) or DCPCs

The use of the E2E technology is not the only option. A candidate partner in the Pilot Project may wish to develop or use specific infrastructure, tools and software (Opensource, self-developed or developed in a wider cooperation context, or even purchased) to provide for WIS connectivity. A centre can act as a WIS NC or DCPC. Requirements are detailed in WIS documentation and available at http://www.wmo.int/pages/prog/www/WIS-Web/RefDocuments.html and particularly in the WIS compliance specifications of Global

Information System Centre (GISC), Data Collection or Production Centre (DCPC), and National Centre (NC) document (draft version 1.0, December 2007).

Access to data and information:

There is a wide variety of types of data and information represented in the list of datasets of the potential and tentatively committed organizations. This translates to a wide variety of hardware platforms, computer security environments and software environments. But though each is different, there are common steps that will be required in order for those datasets to become available through this Pilot Project. These steps are as follows:

a. Each contributor needs to examine the state of the data collections they are considering and to identify which ones they will offer to the Pilot Project;

b. Those contributors wishing to use the E2E technology need to have a discussion with technical experts from the Russian Data Centre to identify exactly what they must do in order for their datasets to become available via ODP. This includes what software must be installed, what information files must be created and where data collections must be placed to be visible;

c. Those contributors wishing to develop or use specific infrastructure, tools and software need to consult with WIS experts to identify exactly what they must do in order for their datasets to become available via WIS. This includes what software must be installed, what information files must be created and where data collections must be placed to be visible;

d. Each contributor needs to commit to devoting resources to make their data collections available. They will also need to identify a local contact for the project and the time frame for completion that is no later than December 2010 (the end of this Pilot Project);

e. Each contributor will work with Russian or WIS experts, as appropriate, to install the necessary software, create any necessary information files and whatever other technical tasks are needed to expose the data collections to the Pilot Project;

f. Each contributor will work with Russian or WIS experts, as appropriate, to verify that their data collections are visible to WIS and ODP; and

g. The Pilot Project will have to define a work plan for making the ODP and WIS interoperable, and ODP acting as a WIS DCPC.

Actions:

2.1 Complete the editorial review of ODP software documentation and make this widely available.

2.2 Each contributor to carry out the necessary steps (as listed above) to provide access to their data or information.

2.3 Define a work plan for making the ODP and WIS interoperable, and ODP acting as a WIS DCPC.

DELIVERABLE 3: PROMOTE QUALITY MANAGEMENT AND STANDARDS

The ad-hoc meeting in Ostend noted that one of the core goals of the Pilot Project would be to coordinate the development of cost-effective end product Quality Management Systems by Members and to propose practical solutions or examples. As stated in the WIGOS Concept of

Operations (CONOPS), many of the WIGOS aims relate to Quality Management, and in particular the following:

> ***Access*:** Facilitate the access, in real/near-real time and delayed-mode, of observations required for WMO and WMO co-sponsored programmes as well as relevant international conventions which are generated by systems implemented and managed by cooperating agencies, organizations and programmes;
>
> ***Standards:*** Ensure required data quality standards are met and sustained for all programme requirements;
>
> ***Quality Management Systems:*** Facilitate improved data management including data processing, archival and data retrieval capabilities; and
>
> ***Documentation:*** Develop appropriate regulatory documentation including organization and recommended practices and procedures.

This Implementation Plan has addressed the issues related to instrument best practices and standards in a previous deliverable. This deliverable covers all of the other practices and standards related to data processing and access.

As the state of standards in oceanography is relatively immature, there will be a significant amount of organizational work required. It will be advantageous for this Pilot Project to designate someone, possibly a contractor, to take on this work, to consult with the appropriate observing panels to assemble existing materials, identify differences to be resolved, encourage submission of documentation and standards and work with CIMO to determine what material is appropriate for WMO and what lies outside.
[Action 3.1]

JCOMM Catalogue of Best Practices and Standards:

WMO has engaged in the Quality Management Framework (QMF) where one of the goals is to produce a catalogue of technical publications related to quality management and their review to ensure adherence to quality management principles. In December 2007, the JCOMM Management Committee recommended producing a catalogue on JCOMM best practices and standards to be published as a JCOMM Technical Document as a high priority need. The Meeting agreed that the ODP-WIGOS Pilot Project for IODE and JCOMM should assist in its development and production. The Meeting also agreed that both the IODE OceanTeacher training facility and the new WIGOS website should be used by the Pilot Project to share appropriate documentation.
[Action 3.2]

IODE/JCOMM Standards process

Assembly of the documentation material from contributors is only the beginning. In January 2008, the IODE and JCOMM held a Standards Forum (see http://www.oceandatastandards.org/) with the objective of agreeing on international standards for managing the data and information[2] collected on and in the ocean. The expectation is that this will create a focus for groups to suggest community standards, to have these evaluated, to get agreement from the broad community to accept the agreed upon standards, and their adoption. The authors of the documented practices of contributors to this Pilot Project will be encouraged to submit these to this Standards Process. In some cases, there will be overlaps in material and differing procedures for the collection, processing or dissemination of data or information about the same parameter. The committee that oversees the standards process, the IODE-JCOMM Expert Team on Data Management Practices (ETDMP), will encourage authors to resolve these differences so that a single practice can move forward.

2 : The word information in this paragraph is used in both WMO and IODE contexts, i.e. it relates to both data and metadata, and to bibliographic information

As standards are recommended, documentation of them should be included in appropriate IOC and WMO publications. Use of the IODE OceanTeacher and a new WIGOS website for sharing this documentation is something to be considered. In particular, the division of material between these two sites, and the marine chapter of the *CIMO Guide* needs to be resolved. This has strong overlaps with actions identified in deliverable 1.
[Action 3.3]

Marine Climatology Information

Meteorological data are collected routinely from ships, buoys, or other platforms and often reported within hours. The data circulate on the GTS and are used in Member and partner operated Numerical Weather Prediction (NWP) systems. There are also systems operated to assemble these data for climatological purposes. These are all managed within the Marine Climatological Summaries Scheme (MCSS) of two Global Collection Centres assembling the various data. These Centres check the data and build a composite dataset for distribution to Members and partners. These data also contribute to the International Comprehensive Ocean and Atmosphere Data Set (ICOADS), a collection of all available surface marine observations dating from the late 1700s to present.

Documentation of the procedures that are followed in processing and archiving the marine meteorological data should be included in appropriate WMO or IOC publications.
[Action 3.4]

Data from NODCs:

In oceanography, there is a well established system of National Oceanographic Data Centres (NODCs), which was established by the IOC's IODE Programme in 1960 to share data and resources. At the global level, the NODCs collaborate with the International Council for Science (ICSU) World Data Centres (WDCs) for oceanography. Each of these NODCs manages the data collected by their own country. Some Centres also manage global datasets. Each of these NODCs operates separately, but meets regularly as the Members of the IODE Committee to discuss issues of international exchange of ocean data. Through some of the international activities between NODCs, some common practices are beginning to emerge. For those NODCs that contribute to this Pilot Project, it will be necessary to assemble the documentation that describes their procedures.
[Action 3.4]

IOC / IODE Information:

Within the IOC community, there are a number of guides, manuals and technical material that describe various aspects of managing oceanographic data. Some of these have been recently updated, whereas some need updating and some are obsolete. A list of these documents and an initial assessment of what needs to be done with each has been compiled, and was made available at the recent Data Management Coordination Group meeting (Ostend, Belgium, March 2008). Some of this material will be superseded as standards are generated through the IODE / JCOMM process, but the timing and strategy for conducting this activity has yet to be determined. One approach to be considered is to focus on documents describing practices that are likely to be updated by standards submitted by contributors to the Pilot Project. It is envisioned that for these documents, minimal updates would be undertaken simply to ensure that present status is represented. Whatever approach is applied to this task, an editor and expert reviewers will be needed to bring this documentation up to date and to coordinate with WMO / CIMO how this material should be referenced.
[Action 3.4]

Information from Oceanographic Observing Projects:

It has become common for international projects in oceanography to establish a Global Data Assembly Centre (GDAC), which is responsible for data assembly and distribution of the data for the project. These GDACs perform a centralized function not only for data, but for information about the project and the project operations and procedures. Some projects are open-ended in time, and once a GDAC is established, it is expected to continue providing this function on a continuing basis.

Each Project and GDAC operates autonomously to set up data management procedures. However, because of overlaps in personnel between projects, there are strong similarities between the GDACs due to the adoption of a few common practices rather than a concerted effort at standardization. For those GDACs that become part of the Pilot Project, it will be necessary to assemble and compare the material they have describing their operations, then to include them in the JCOMM catalogue of Best Practices and Standards, and make reference to relevant parts in the WMO and / or IOC Manuals and Guides. Appropriate material will be encouraged to be submitted to the IODE/JCOMM Standards Process.
[Action 3.5]

Information about Data Management Projects:

In the past few years, individual countries (e.g., Australia, United States) and consortia of countries (such as the European Union's SeaDataNet Project) have started to build comprehensive data management systems for marine data. Each of these projects has had the need to address standards and they are producing national or project documentation that describes what has been decided. Contributions to the Pilot Project are going to come from individual countries, and to the extent that they have standards, they will be encouraged to submit them to the IODE/JCOMM Standards Process for broader review, possible modification and adoption. The ET-DMP will need to play the same coordination role here as for documentation from GDACs.
[Action 3.6]

Actions:

3.1 An editor and reviewers are needed to assemble the documentation on standards and best practices of contributors to this project. Their task is also to recommend where such material should be stored and how it can be made available.

3.2 The organizational task identified in action 3.1 should also assume the task of providing appropriate references to the *JCOMM Catalogue of Best Practices and Standards*.

3.3 The person responsible for organizing documentation as referenced in action 3.1 should also resolve the most appropriate location for documentation to be held, between the IODE OceanTeacher, WIGOS website and the *CIMO Guide*.

3.4 Assemble the documentation or references that describe data management procedures carried out at MCSS centres and at NODCs that contribute to this Pilot Project. There is also material in IOC Manuals and Guides and other such publications that are relevant and should be considered.

3.5 Assemble material or references that describe operations of the various GDACs contributing to the Pilot Project, include them in the *JCOMM Catalogue of Best Practices and Standards*, and make reference to relevant parts in appropriate WMO and / or IOC manuals and guides.

3.6 Assemble material or references that describe operations of national or multi-national data management projects particularly as they develop standards. Encourage the authors of the documented practices of contributors to this Pilot Project to submit these to the joint IODE/JCOMM Standards Process.

PROJECT MANAGEMENT

This ODP-WIGOS Pilot Project for IODE and JCOMM is funded by the WMO until the end of 2010. By this date, participants will need to show that a significant number of marine data collections are available to the WIGOS/WIS, or that developments have started and plans and commitments are being made by Members to realize it. The precise timing of what data collections become available is difficult to identify at this point. This will become clearer as discussions are held between the individual data holders and Russian experts in the E2E technology or WIS experts, as appropriate. For this reason, the timetable listed in the Annexes is less precise than it should be. However, it includes all of the actions listed in this implementation plan, and the order in which they should be completed and suggested due dates for completion.

The Pilot Project should refine its Business Plan and particularly develop a cost / benefit analysis. For example, it would be useful for convincing the WMO and IOC Members to commit resources in the Pilot Project if they had information about the improvements in final products – serving end user needs - gained from additional observing stations, better quality data, more timely data, or the integration of additional datasets in the WIS. Those improvements should be quantified, the costs involved in making those improvements estimated, and then compared with the estimated benefits for each targeted end user (e.g., insurance companies, transportation industry, energy industry, safety authorities, etc.).
[Action 4.1]

The Pilot Project should designate members of the Steering Group to be responsible to follow up and remain pro-active with regard to the integration of specific datasets and the development of synergies with specific demonstration projects and reporting.
[Actions 4.2, 4.3]

Actions:

4.1 Refine the business plan and initiate a cost / benefits analysis.

4.2 Nominate Pilot Project Steering Group members to follow up integration of specific datasets and the development of synergies with specific demonstration projects.

4.3 Provide reports as required to parent bodies of WMO and IOC.

DEMONSTRATION PROJECTS AND CAPACITY-BUILDING

The ad hoc planning meeting (Ostend, Belgium, 29 March) agreed that one or more of the WIGOS Demonstration Projects should be associated with the JCOMM Pilot Project for WIGOS. The Meeting identified Morocco (RA I), USA (RA IV), Australia (RA V), and the Russian Federation (RA VI) as potential candidates. Meanwhile, Brazil has refined its Pilot Project, which also shows some interesting potential synergies with the ODP-WIGOS Pilot Project for IODE and JCOMM. The Pilot Project will approach those Pilot Projects, explore the synergies, and make recommendations for establishing collaborations, as appropriate.

In terms of capacity-building, the Pilot Project has already identified the following possible actions:

- Producing appropriate training materials, updating the E2E documentation, and reviewing the marine chapter of the WMO Publication No. 8 (*CIMO Guide*);

- Organizing training courses at the IOC Project Office for IODE in Ostend, Belgium. Themes for the training courses can include E2E technology, WIS interoperability, best practices and standards, instrument evaluation and intercomparisons;

- Asking participants of the 2007 E2E training courses to participate in the Pilot Project;

- The WMO Education and Training Programme (ETRP) would be an effective mechanism for promoting WIGOS and the JCOMM Pilot Project in developing countries by providing training materials and training courses to them;

- The IODE Ocean Data and Information Networks (ODINs) could substantially help developing countries to benefit from the Pilot Project by engaging in it as partners; and

- Providing experts to visit centres willing to join the Pilot Project.

Action:

5.1 Address capacity-building issues according to the guidelines mentioned-above.

LEGACY

The Pilot Project is aiming at rationalizing documentation on instrument best practices and standards, promoting the establishment of regional or specialized marine instrument centres, integrating several marine datasets in the WIGOS framework through interoperability arrangements with the WIS, and addressing quality management issues and how specific centres could implement Quality Management Systems (QMS). Much work will remain after the end of the Pilot Project in order to achieve the vision expressed in the WIGOS CONOPS. The Pilot Project will have to propose the governance through which the principles developed under WIGOS will permit continued progress and managing the sustainability of the integrated observing system.

Action:

6.1 Address legacy issues in the view to make proposals for the WMO Cg-XVI through the WMO EC WG on WIGOS-WIS and its sub-group, as appropriate.

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ANNEX IV

STATUS OF THE IMPLEMENTATION PLAN

(as of 3 November 2010)

PROGRESS, STATUS OF IMPLEMENTATION, AND UPDATED TARGETS, ON THE OVERARCHING IMPLEMENTATION PLAN FOR THE ODP AND WIGOS PILOT PROJECT FOR THE IODE AND JCOMM

(updated version of Annex I of the Implementation Plan[1] adopted at the second meeting of the joint Steering Group for the IODE Ocean data Portal and the WIGOS Pilot Project for JCOMM, Ostend, Belgium, 15-16 October 2009)

ACTION ITEMS AND RELATED SUB-TASKS OF THE ODP-WIGOS PILOT PROJECT FOR IODE AND JCOMM

Deliverable 1: Documenting and integrating instrument best practices and related standards

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
PP Steering Group Representative to coordinate with the ETMC, SOT, DBCP, GLOSS and Argo.	**Action 1.1 "Information on marine meteorological parameters":** Review the marine chapter of the *CIMO Guide*. Provide updates and additions on meteorological instruments and methods of observation, as necessary.	Done. Agreement is secured for some changes. Strategy for updating WMO and IOC Technical Publications adopted at the ODP-WIGOS meeting in Oct. 2009.	Done	for coordination
	Sub-tasks:			
PP Steering Group	**1.1.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
Chairperson OCG to liaise with OPA Panels and address additions to *Guide* at OCG-III.	**1.1.2** Secure agreement on proposed changes from within the marine community, including WMO Members, regarding the operation, of marine instruments and methods of observation.	Done (changes to CIMO Guide approved)	Done	
Chairperson OCG	**1.1.3** Conduct discussions with the Data Buoy Co-operation Panel at its twenty-fourth session (Cape Town, South Africa).	Done.	Done	$10k from DBCP $10k from WMO

1: http://www.wmo.int/pages/prog/www/wigos/documents/Impl_Plan_JCOMM.pdf

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
	Expected outcome is progress regarding integration of best practices and standards for buoy observations and a submission to the IODE / JCOMM Standards Process.			
Co-chairpersons PP	**1.1.4** Co-chairpersons will participate in discussions with the JCOMM Ship Observations Team at its fifth Session.	Done.	Done	
Jitze van der Meulen, Chung-Chu Teng	**1.1.5** Coordinate changes with the Rapporteur on the *CIMO Guide*.	Done.	Done	
PP Steering Group, Secretariats, contractor, CIMO Guide Rapporteur, Chairperson OCG	**Action 1.2 "Information from the JCOMM Observations Programme Area (OPA) Panels":** Assemble reference material on instrument best practices and standards available from the JCOMM OPA Panels and associated observing programmes for inclusion in the JCOMM catalogue of best practices and standards.	Done (Catalogue with 64 Publications available on-line at http://bestpractice.iode.org/)	Done	$30k
	Sub-tasks:			
Chairperson OCG	**1.2.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
Chairperson OCG	**1.2.2** Begin assembly of relevant documentation and / or references.	Done.	Done	
Chairperson OCG	**1.2.3** Work with CIMO, WMO and IOC Representatives to determine what material is appropriate for CIMO, for WMO or IOC *Manuals* and *Guides.*	Done.	Done	
Dr Chung-Chu Teng, ET-DMP, Chairperson OCG, CIMO Guide Rapporteur	**Action 1.3 "Documenting Instrument Best Practices":** As standards are adopted, editors from the Pilot Project and CIMO will need to work together to prepare the material for inclusion in the marine chapter of the *CIMO Guide.*	Partly done (concept proven)	Partly Done;	
	Sub-tasks:			
Chair ET-DMP, Chairperson OCG, CIMO	**1.3.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
Guide Rapporteur				
Chair ET-DMP, Chairperson OCG	**1.3.2** Collect standards.	Done.	Done	
Chairperson ET-DMP, Chairperson OCG	**1.3.3** Reconcile differences in standards.	Partly done (some noted differences have to be addressed)	Legacy	
Dr Chung-Chu Teng, ET-DMP, Chairperson OCG, CIMO Guide Rapporteur	**1.3.4** Prepare agreed upon standards for inclusion into *CIMO Guide.*	Done.	Done	
Dr Teng, OPA Panel Chairpersons, Chairperson OCG, CIMO Guide Rapporteur	**Action 1.4 "Instrument Centres":** Dr Teng will discuss with CIMO about ocean instrument centres, and liaise with appropriate OPA experts, such as the Chairperson of the SOOPIP, the DBCP and other appropriate Panels. The Project may need to propose and agree on Terms of Reference (ToR) for the JCOMM Instrument Centres, and develop guidelines for running them. It should propose guidelines regarding the costs involved for setting up and running such centres.	Done. (RMIC Established by JCOMM-III; RMIC for RA-IV in USA established; workshop held in USA in April 2010 to prove concept; plans for China and Morocco agreed upon)	Done	
	Sub-tasks:			
Dr Teng	**1.4.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
PP Steering Group	**1.4.2** Begin collaboration with CIMO, the WIGOS/WIS Development Team, and other program representatives involved in WIGOS and prepare for the potential future development of ocean instrument centres.	Done.	Done	
Dr Teng, R. Dombrowsky, J. Gorman	**1.4.3** Investigate the need for and if required develop a proposal for the creation of regional ocean instrument centres (and address the level of operations of instrument centres to include Terms of Reference to be presented at the	Done.	Done	

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
	next OCG meeting.			
Dr Teng, R. Dombrowsky, J. Gorman	**1.4.4** Following OCG agreement to the proposal, identify potential Ocean Instrument Centres and select one of the candidate centres as the initial demonstration prototype.	Done.	Done	$20k
Dr Teng, R. Dombrowsky, John Gorman	**1.4.5** Prepare and present a report on the project.	Done.	Done	
Co-chairperson PP, Chairperson Meta-T, S. Belov and E. Christian	**Action 1.5 "Platform/Instrument metadata":** The Pilot Project should determine if and how the information assembled by the JCOMM META-T Project can be included, as well as propose a strategy for including other variables than SST and water temperature profiles in the platform / instrument metadata collection, distribution, and archiving system being developed.	Not done. META-T to develop a proposal for the IODE / JCOMM Standards process. Done. Discussed at JCOMM-III, and Recommendation issued. Done. Report was submitted to SOT-V Done. XBT BUFR template reviewed for inclusion of metadata, and approved for validation by IPET/DRC. Done. VOS and buoy templates progressing; buoy template to be reviewed by DBCP	Legacy	
	Sub-tasks:			
D. Snowden	**1.5.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
S. Belov, D. Snowden, J. Chen, B. Burnett	**1.5.2** Begin collaboration with the Chairperson of the META-T, Russian experts, ET-AWS, ET-DRC, and the WIS IPET-MI Expert Teams on how information should be assembled within WIGOS / WIS.	Not done. Proposal to have Pub47 metadata included in WIS, as well as regulatory part included in the future WIS manual, was made at SOT-V. JCOMM and CBS should work together to make proposal at CBS Session in 2011. Not done. US META-T to be developed as part of the Sensor Observation Services (SOS); US IOOS Program and NOAA's Climate Observation Program have agreed to support	Legacy	

Responsibility:	*Actions and related Sub-Tasks:*	*Status / Comments:*	*Deadline*	*Cost :*
		metadata services to the ODP and the WIS.		
D. Snowden, J. Chen, B. Burnett	**1.5.3** Develop a proposal for meeting the requirements for such data collection, distribution and archival.	Partly done. META-T users survey underway per SOT-V recommendation Done: ETMC-III (Feb 2010) proposed a trial of META-T and ODASMS facilities	Legacy	
J. Chen, B. Burnett	**1.5.4** Following acceptance of the proposal, begin the implementation of the proposed strategy.	Not done.	Legacy	
D. Snowden	**1.5.5** Prepare a report on the status of the implementation.	Not done.	Legacy	
J. Chen, B. Burnett	**1.5.6** Demonstration by JCOMM-III.	Not done.	Not done	
S. Belov	**1.5.7** Demonstrate ODP connectivity.	Not done. ETDMP-II included this in the ETDMP workplan	Legacy	
Co-chairperson PP, Chairperson VOS / VOSClim , S. Belov, WIS Support Team	**Action 1.6 "VOS Metadata":** The Pilot Project should determine if and how the information assembled by the VOS and VOSClim Projects can be included.	Done. SOT-V discussed and agreed on a proposal to consider VOSClim as an additional class of VOS. This implied updating: • WMO No 471 (Guide to Marine Met Services); Done (JCOMM-III) • WMO No. 544 (Manual on the GOS, to be updated by CBS in 2011) • WMO No. 488 (Guide on the GOS, to be updated by CBS in 2011) • JCOMM TD No.4 (VOS Scheme framework document); Underway SOT-V proposed to copy Pub47 submissions to JCOMMOPS.	Done	
	Sub-tasks:			
S. Woodruff, J. Fletcher, N. Scott	**1.6.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
S. Woodruff, J. Fletcher, N. Scott, N. Mikhaylov, S. Belov	**1.6.2** Begin collaboration with the VOS / VOSClim and Russian experts and WIS Support Team.	Done. Integration of VOSClim as part of the wider VOS completed. Not done. Managing VOS/VOSClim	Done Legacy	

Responsibility:	*Actions and related Sub-Tasks:*	*Status / Comments:*	*Deadline*	*Cost :*
		metadata as part of WIS involves splitting WMO Pub 47 in two parts: Regulatory part to be integrated in a future WIGOS manual Database and its metadata to become part of WIS This needs to be discussed by CBS in a wider context as part of the WIGOS implementation phase (2012-2015) Done. Managing VOS/VOSClim metadata as part of ODP requires assistance from JCOMMOPS and testing	 Done	
S. Woodruff, J. Fletcher, N. Scott, N. Mikhaylov, S. Belov	**1.6.3** If determined to be feasible, prepare a proposal for inclusion of VOS and VOSClim projects.	Done. WMO No. 471 updated (JCOMM-III, EC-LXII); Done: JCOMM TD No. 4 was updated; Done: VOSClim integration trial Not done: WMO Technical Regulation to be updated as part of the proposed strategy	Done Done Done Legacy	
S. Woodruff, J. Fletcher, N. Scott, N. Mikhaylov, S. Belov	**1.6.4** Begin implementation.	Done: VOSClim test-phase started on 1 June 2010	Done	
WMO and IOC Secretariats	**Action 1.7 "Cooperation with the manufacturers":** WMO and IOC Secretariats to write to the marine instrument manufacturers and invite them to be represented through the Association of Hydro-Meteorological Equipment Industry (HMEI), to consider organizing training workshops and developing cooperation with the Pilot Project.	Partly done. Discussion underway with HMEI; letter to Members drafted but pending discussions with IOC about HMEI status	Legacy	
	Sub-tasks:			
WMO Secretariat	**1.7.1** Monitor progress, make adjustments	Partly done.	Legacy	

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
	and refine targets of action.	HMEI participated at SOT-V; and manufacturers were invited through HMEI.		
WMO and IOC Secretariats	**1.7.2** Initiate correspondence with HMEI and resolve any concerns HMEI and non-HMEI may have with establishing a process by which manufacturers become more actively involved with WIGOS activities.	Done. Principle agreed at JCOMM-III (Nov 2009); Not done: IOC invited by JCOMM-III to investigate whether such as status can be granted to HMEI as well	Done Legacy	
WMO Secretariat	**1.7.3** Invite HMEI representative(s) within the WMO to future Steering Group session.	Done.	Done	
WMO and IOC Secretariats	**1.7.4** Secure agreements similar to those that CIMO has with HMEI, through which HMEI assists, in conducting instrument training workshops.	Partly done (agreement in principle that HMEI will assist through RMIC activities)	Legacy	

Deliverable 2: Build marine data systems that are interoperable with the WIS

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
Review Group (G. Reed, R. Keeley, S. Belov), WIS Support Team	**Action 2.1 "ODP software documentation":** Complete the editorial review of software documentation and make this widely available.	Done. Documentation available on ODP website.	Done	
	Sub-tasks:			
Review Group, WIS-PO	**2.1.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
Review group, DMCG, PP Steering Group, WIS-PO	**2.1.2** Review software documentation.	Done. Documentation on Integration Server, Data Provider & Light Data Provider	Done	
WIS-PO, E. Christian	**2.1.3** Organize E2E Workshop with WIS PO to address E2E and WIS technologies and interoperability issues in order to refine ODP v1, and produce plan for ODP v2. In collaboration with the WIS Project Office, prepare a summary of the results and making them widely available.	Done.	Done	CHF 5000 (from WIS-PO)
Candidate centre representatives, WIS Support Team, PP Support Team	**Action 2.2 "Potential datasets":** Each contributing centre to carry out the necessary steps (as listed in deliverable 2 of the document) to provide access to their data or information.	Partly done.	Legacy	
	Sub-tasks:			
PP Steering Group	**2.2.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
Candidate centre representatives, PP Support Team	**2.2.2** Coordinate with contributors to identify which datasets they will offer to the Pilot Project. Consider developing virtual infrastructure for connecting specific datasets.	Done.	Done	
WMO and IOC Secretariats, S Belov	**2.2.3** Determine which contributors will be utilizing the E2E technology and direct them to technical experts from the Russian Data Centre to identify exactly what they	Done (for existing data providers)	Done	

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
	must do in order for their datasets to become available via ODP. This includes software to be installed, the creation of information files and where data collections must be placed for visibility and user access.			
WMO and IOC Secretariats, PP Support Team	**2.2.4** Identify local contacts for the project.	Done (for existing data providers)	Done	
PP Support Team	**2.2.5** Discuss with each contributor what commitment is needed to WIS, as well as the level of resources required to make their data collections available.	Partly done.	Legacy	
PP Support Team	**2.2.6** As needed visit candidate centres for completion of implementation that is no later than end of 2Q 2009.	Done.	Done	PP Budget
PP Steering Group	**2.2.7** Insure that implementation is completed by December 2010, the end of this Pilot Project.	Partly done.	Legacy	
Candidate centre representatives, WIS Support Team, PP Support Team, ODP	**Action 2.3 "ODP-WIS interoperability":** Define a work plan for making the ODP and WIS interoperable, and ODP (v1) acting as a WIS DCPC.	Done.	Done	
	Sub-tasks:			
PP Steering Group	**2.3.1** Monitor progress, make adjustments and refine targets of action.	Done. Workshop held in Obninsk in March 2009 Done. DMCG-IV recommended that CBS ET-WISC addresses documenting the interface between the ODP and GISCs, and ODP and the GISC in Germany to work on the specifications of this interface. Completed the version 1 of ODP including interoperability with WIS by June 2010. Completed v2. Interoperability	Done	

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
		components WIS specified Not done. Germany and Russia to work together to demonstrate technical realization of interoperability between the ODP and a GISC .	 Legacy	
B. Burnett, E. Christian, S. Belov	**2.3.2** Contributors who wish to develop or use specific infrastructure, tools and software to consult with WIS experts to identify exactly what they must do in order for their datasets to become available via WIS.	Done.	Done	

Deliverable 3: Promote Quality Management standards

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
PP Steering Group, IODE Officers, CIMO Representative	**Action 3.1 "Review of standards":** An editor and reviewers are needed to assemble the documentation on standards and best practices of contributors to this project. Their task is also to recommend where such material should be stored and how it can be made available.	Done.	Done	
	Sub-tasks:			
IODE Officers	**3.1.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
J. van der Meulen, IODE Officers	**3.1,2** Identify the ad hoc working group of editors and reviewers of IOC / IODE materials.	Done.	Done	
IODE Officers	**3.1.3** Identify IOC /IODE material requiring an update.	Done.	Done	
IODE Officers	**3.1.4** Discuss and prepare materials for publication.	Done.	Done	
IODE Officers	**3.1.5** Publish material.	Done.	Done	
Contractor, Chairperson OCG, Chairperson DMCG	**Action 3.2 "JCOMM Catalogue of Best Practices and Standards":** The organizational task identified in action 3.1 should also assume the task of providing appropriate references to the *JCOMM Catalogue of Best Practices and Standards*.	Done.	Done	
	Sub-tasks:			
IODE-PO, Chairperson OCG	**3.2.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
Contractor	**3.2.2** Assemble existing materials.	Done.	Done	
Contractor	**3.2.3** Identify and resolve differences in the materials assembled.	Done.	Done	
ET-DMP	**3.2.4** Submission of new standards or updates to existing standards for review and approval.	Done.	Done	

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
Chairperson DMCG	**3.2.5** Collaborate with WMO and IODE to determine the appropriate disposition of all submitted materials.	Done.	Done	
Contractor, CIMO, IODE-PO and ETRP.	**Action 3.3 "JCOMM/IODE Standards process":** The person responsible for organizing documentation as referenced in action 3.1 should also resolve the most appropriate location for documentation to be held, between the IODE OceanTeacher, WIGOS website and *CIMO Guide*.	Done.	Done	
	Sub-tasks:			
IODE-PO, Chairperson OCG	**3.3.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
IODE-PO, R. Dombrowsky	**3.3.2** Begin collaboration with the IODE OceanTeacher, WIGOS development team and CIMO on the development of a strategy for organizing documentation on ocean monitoring instruments, methods of observation, data and products.	Done.	Done	
Contractor	**3.3.3** Develop a proposal for the cross-referencing ocean related information on monitoring instruments, methods of observation, data and products.	Done.	Done	
PP Steering Group	**3.3.4** Acquire approval of proposal.	Done.	Done	
PP Steering Group	**3.3.5** Begin Proposal Implementation process.	Done (ETDMPII workplan)	Done	

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
PP Steering Group, Chairperson OCG, Chairperson DMCG	**Action 3.4 "Marine climatology, NODCs, IOC/IODE Information":** Assemble the documentation or references that describe data management procedures carried out at MCSS centres and at NODCs that contribute to this Pilot Project. There is also material in IOC Manuals and Guides and other such publications that are relevant and should be considered.	Partly done.	Legacy	
	Sub-tasks:			
PP Steering Group	**3.4.1** Monitor progress, make adjustments and refine targets of action	Done.	Done	
PP Steering Group , S. Belov	**3.4.2** Begin assembly of relevant documentation and / or references	Partly done.	Legacy	
Chairperson DMCG	**3.4.3** Consult with the appropriate groups to assemble existing materials, identify differences to be resolved, encourage submission of documentation and standards.	Partly done.	Legacy	
Dr Teng, CIMO Guide Rapporteur	**3.4.4** Work with CIMO to determine what material is appropriate for the WMO *CIMO Guide* and what lies outside.	Done.	Done	
PP Steering Group, Secretariats, Contractor	**Action 3.5 "Information from Oceanographic Observing Projects - GDACs":** Assemble material or references that describe operations of the various GDACs contributing to the Pilot Project, include them in the *JCOMM Catalogue of Best Practices and Standards*, and make reference to relevant parts as appropriate to WMO and / or IOC *Manuals* and *Guides*	Not done.	Legacy	
	Sub-tasks:			
Chairperson OCG	**3.5.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
Chairperson OCG	**3.5.2** Begin assembly of relevant	Done.	Done	

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
	documentation and / or references.	Documentation on GDACs exists on the web to be added in the JCOMM Catalogue e.g. • GHRSST Data Specification Version 2.0 available at: http://www.ghrsst.org/modules/documents/documents/GDS2.0_TechnicalSpecifications_v2.0.pdf • OceanSITES document available at: http://www.oceansites.org/documents/index.html • GTSPP: http://www.nodc.noaa.gov/GTSPP/document/index.html • GOSUD: http://www.ifremer.fr/gosud/documentation.htm • Argo: http://www.argodatamgt.org/Documentation • GDP: http://www.aoml.noaa.gov/phod/dac/dacdata.php		
Chairperson OCG	**3.5.3** Work with WMO and IOC Representatives to determine what material is appropriate for WMO or IOC *Manuals* and *Guides.*	Partly done.	Legacy	

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
DMPA, ET-DMP, Contractor	**Action 3.6 "Information about Data Management Projects":** Assemble material or references that describe operations of national or multi-national data management projects particularly as they develop standards. Encourage the authors of the documented practices of contributors to this Pilot Project to submit these to the joint IODE / JCOMM Standards Process.	Done.	Done	
	Sub-tasks:			
Chairperson DMCG, Chairperson ET-DMP	**3.6.1** Monitor progress, make adjustments and refine targets of action.	Done (ETDMP-II workplan)	Done	
ET-DMP	**3.6.2** Secure and compare inputs provided by contributors to the Pilot Project.	Done.	Done	
ET-DMP	**3.6.3** Mediate differences for resolution.	Partly done (Underway by ETDMP Task Team on Standards)	Legacy	
IODE-PO	**3.6.4** Post an updated document stating the IODE / JCOMM Standards Process.	Done.	Done	

Deliverable 4: Project Management

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
PP Steering Group	**Action 4.1 "Business Plan":** Refine the business plan and initiate a cost / benefits analysis.	Done (second meeting of the joint Steering Group (Oct 2009) decided to produce a project report instead of a business plan)	Done	
	Sub-tasks:			
PP Steering Group	**4.1.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
PP Steering Group	**4.1.2** As an element of the Business Plan prepare a cost/benefit analysis.	Not done (PP agreed that it was not realistic to achieve within available budgets)	Not done	
Secretariat, contributing centre representatives, WIS Support Team	**Action 4.2 "Follow up of potential datasets":** Nominate Pilot Project Steering Group members to follow up integration of specific datasets and the development of synergies with specific demonstration projects.	Done.	Done	
	Sub-tasks:			
PP Steering Group	**4.2.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
PP Steering Group	**4.2.2** Nomination of Steering Group Members.	Done.	Done	
PP Steering Group	**4.2.3** Identify specific datasets, which have the greatest potential for developing synergies with WIGOS pilot and demonstration projects.	Done.	Done	
PP Steering Group	**4.2.4** Approach these projects to see how the ODP-WIGOS Pilot Project for IODE and JCOMM could assist / partner through the integration of datasets.	Done.	Done	
Individual contributors, N. Mikhaylov	**4.2.5** Prepare a strategy for data collaboration with the identified projects.	Done.	Done	
Individual contributors, N. Mikhaylov	**4.2.6** Implement the agreed upon strategy.	Done.	Done	

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
Chairperson PP Steering Group	**Action 4.3** "**Reporting to parent bodies**" Steering Group Reports, Presentations and Meetings	Done.	Done	
	Sub-tasks:			
Chairperson of PP Steering Group, R. Dombrowsky	**4.3.1** Prepare and provide periodic status reports on the progress of the PP to the Sub-Group WIGOS-WIS per EC-WIGOS WIS Working Group requirements.	Done.	Done	
R. Keeley or G. Reed	**4.3.2** Report pilot project progress to JCOMM Management Committee.	Done.	Done	
R. Dombrowsky	**4.3.3** Attend Working-Group WIGOS-WIS planning and reporting sessions.	Done.	Done	
G. Reed	**4.3.4** Presentation to IODE-XX: Expected outcome: formal endorsement and Resolution from IODE on participation of ODP in this Pilot Project.	Done.	Done	
PP Steering Group	**4.3.5** Meeting to assess progress and address (Action 6.1) Steering Group to address legacy of WIGOS PP.	Done.	Done	
R. Keeley	**4.3.6** Presentation to JCOMM-III. Expected outcome: formal endorsement and Resolution calling the WMO and IOC Members to participate and contribute to the Pilot Project.	Done.	Done	
PP Steering Group	**4.3.7** Meeting to assess progress and address (Action 6.1) Steering Group to address legacy of PP.	Done.	Done	
G. Reed	**4.3.8** Presentation to JCOMM Management Committee reporting results of PP.	Done.	Done	
Chairperson of PP Steering Group	**4.3.9** Draft report for WMO Cg-XVI. Legacy of WIGOS proposed by the Pilot Project.	Done.	Done	
	4.3.10 Report to WMO Cg-XVI on legacy of WIGOS proposed by the Pilot Project.	Planned.	Planned	

Deliverable 5: Demonstration projects and capacity-building

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
JCOMM, ODP representatives in collaboration with ETRP	**Action 5.1 "Capacity Building":** Address capacity-building Issues according to the guidelines provided within the document.	Done.	Done	
	Sub-tasks:			
JCOMM, ODP representatives in collaboration with ETRP	**5.1.1** Monitor progress, make adjustments and refine targets of action	Done.	Done	
S. Belov, CIMO Representative	**5.1.2** Review existing training materials, updating the E2E documentation, and reviewing the marine chapter of the WMO Publication No. 8 (*CIMO Guide*) and update, as appropriate.	Done.	Done	
IODE-PO, PP Support Team	**5.1.3** Organize training courses. Suggested themes for training courses to include such topics as E2E technology, WIS interoperability, best practices and standards, instrument evaluation and intercomparisons.	Done.	Done	
IODE-PO	**5.1.4** Approach the WMO Education and Training Programme (ETRP) for promoting WIGOS and the JCOMM Pilot Project in developing countries by providing training materials and training courses for their delivery.	Done.	Done	

Deliverable 6: Legacy

Responsibility:	***Actions and related Sub-Tasks:***	***Status / Comments:***	***Deadline***	***Cost :***
PP Steering Group	**Action 6.1 "Legacy":** Address legacy issues in the view to make proposals for the WMO Cg-XVI through the WMO EC WG on WIGOS-WIS and its sub-group, as appropriate.	Done.	Done	
	Sub-tasks:			
PP Steering Group	**6.1.1** Monitor progress, make adjustments and refine targets of action.	Done.	Done	
PP Steering Group	**6.1.2** Prepare its final report for WMO Cg-XVI through the WMO EC WG on WIGOS-WIS and its Sub-group.	Done.	Done	
PP Steering Group	**6.1.3** Conduct meeting to assess pilot progress and address legacy of ODP-WIGOS Pilot Project for IODE and JCOMM and prepare presentation.	Done.	Done	
Chairperson of PP Steering Group	**6.1.4** Provide presentation of progress to JCOMM Management Committee.	Done.	Done	

ANNEX V

TERMS OF REFERENCE OF WMO-IOC REGIONAL MARINE INSTRUMENT CENTRES (RMIC)

RECOMMENDATION

Rec. 1 (JCOMM-III) — ESTABLISHMENT OF WMO-IOC REGIONAL MARINE INSTRUMENT CENTRES (RMIC)

THE JOINT WMO-IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY,

Noting:

(1) The JCOMM Terms of Reference, especially in relation to: (i) the development of observing networks; (ii) the provision of capacity building to Member States; and (iii) assistance in the documentation and management of the data in international systems,

(2) Resolution 30 (Cg-XV) – Towards Enhanced Integration between WMO Observing Systems,

(3) The final report of the First and Second Sessions of the WMO Executive Council Working Group on WIGOS and WIS,

(4) The final report of the *ad hoc* planning meeting for the JCOMM Pilot Project for WIGOS (JCOMM/MR-No. 57),

(5) The final report of the meeting of the joint Steering Group for the UNESCO/IOC-IODE Ocean Data Portal (ODP) and the WIGOS Pilot Project for JCOMM (JCOMM/MR-No. 59),

(6) The final report of the Twenty-fourth Session of the Data Buoy Cooperation Panel (JCOMM/MR-No. 61),

(7) The final report of the First Session of the Sub-Group of the WMO Executive Council Working Group on WIGOS and WIS,

(8) The final report of the Seventh Session of the JCOMM Management Committee (JCOMM/MR-No. 62),

(9) The final report of the Fifth Session of the JCOMM Ship Observations Team (SOT) (JCOMM/MR-No. 63),

Noting further:

(1) The WIGOS Concept of Operations (CONOPS) as adopted by WMO EC-LXI,

(2) The WIGOS Development and Implementation Plan (WDIP) as adopted by WMO EC-LXI,

(3) The Project Plan of the WIGOS Pilot Project for JCOMM,

(4) The overarching Implementation Plan for the UNESCO/IOC-IODE Ocean Data Portal (ODP) and WIGOS Pilot Project for JCOMM,

(5) The proposal from the US to run a RMIC on a trial basis at the NOAA National Data Buoy Centre (NDBC),

Having considered:

(1) Members/Member States need for high quality marine meteorology and oceanographic measurements from the world oceans to address the requirements of WMO and UNESCO/IOC programmes and co-sponsored programmes,

(2) The need for facilities for the regular calibration and maintenance of marine instruments and the monitoring of instrument performance, on a regional basis in order to address adherence of ocean observations and associated metadata to high level standards for instruments and methods of observation,

(3) The need for documenting methods of measurements, for understanding biases introduced by each type of instrumentation, and for developing methods to correct such biases, in order to achieve delivery and use of coherent data sets,

(4) That RMICs would facilitate fulfilling these requirements,

(5) The role that RMICs could play with regard to instrument comparisons and evaluations, as well as for the training of marine meteorology and oceanography instrument experts;

Recognizing:

(1) The experience gained by the WMO Commission for Instruments and Methods of Observation (CIMO) regarding establishment and operations of Regional Instrument Centres (RIC) and World and Regional Radiation Centres (WRC and RRC),

(2) The necessity of close coordination with CIMO on establishing the network of RMIC to take into account the experience of establishing and operating the RICs and to avoid potential duplication of activities between RMICs and RICs,

(3) Expertise of Members/Member States with regard to marine meteorology and oceanography instrument best practices, as well as the dedicated facilities they operate,

(4) The excellent facilities and long experience of the National Data Buoy Centre (NDBC) regarding ocean instrument calibration, evaluation, and deployment,

Recommends:

(1) To establish a network of Regional Marine Instrument Centres (RMIC) and a mechanism for formal WMO and UNESCO/IOC designation of RMIC where:

   (a) Governance for defining the functions and adoption of RMIC is proposed by JCOMM and endorsed by the WMO and UNESCO/IOC Executive Councils;

   (b) Candidate RMIC will be required to produce a statement of compliance, list capabilities of the proposed centre, state the suite of instrument expertise offered, state the formal commitment to voluntarily host the centre, and demonstrate capability to JCOMM;

   (c) Following possible agreement by JCOMM, the WMO and UNESCO/IOC Executive Councils will be invited to accept and approve new RMICs;

   (d) Terms of Reference of RMIC will become part of the *WMO Guide to Meteorological Instruments and Methods of Observations* (WMO-No. 8);

(2) That the Terms of Reference of RMIC, including capabilities, and corresponding functions should be as given in the Annex to this recommendation;

(3) That the National Data Buoy Centre (NDBC) of the US undertakes the functions of a RMIC on a trial basis and reports on the results to JCOMM with a view to eventually become a RMIC under the mechanism defined above;

Invites:

(1) Members/Member States to consider taking advantage of the RMIC resources offered by the NDBC on a trial basis as appropriate;

(2) Members/Member States to consider proposing new RMICs as they see fit;

Requests the Secretary-General of WMO and the Executive Secretary of UNESCO/IOC to facilitate implementation of this recommendation and provide appropriate technical advisory assistance to Members/Member States concerned as required, in the operations of RMICs.

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Annex to draft Recommendation 1 (JCOMM-III)

TERMS OF REFERENCE FOR A WMO-IOC REGIONAL MARINE INSTRUMENT CENTRE

WMO-IOC Regional Marine Instrument Centres (RMIC) should have the following capabilities to carry out their corresponding functions:

Capabilities:

(a) A RMIC must have, or have access to, the necessary facilities and laboratory equipment to perform the functions necessary for the calibration of meteorological and related oceanographic instruments deployed to address the common requirements of WMO and UNESCO/IOC marine-related programmes and co-sponsored programmes[1];

(b) A RMIC must maintain a set of meteorological and oceanographic standard instruments or references and establish the traceability of its own measurement standards and measuring instruments to the International System of Units (SI);

(c) A RMIC must have qualified managerial and technical staff with the necessary experience to fulfil its functions;

(d) A RMIC must develop its individual technical procedures for the calibration of meteorological and related oceanographic instruments using calibration equipment employed by the RMIC;

(e) A RMIC must develop its individual quality assurance procedures;

(f) A RMIC must participate in, or organize, inter-laboratory comparisons of standard calibration instruments and methods;

(g) A RMIC must utilize the resources and capabilities of its region of interest according to the region's best interests, when appropriate;

(h) A RMIC must apply international standards applicable for calibration laboratories, such as ISO/IEC 17025, to the extent possible;

(i) A recognized authority[2] must assess a RMIC, at least every five years, to verify its capabilities and performance.

Corresponding functions:

(a) A RMIC must assist Members/Member States of its region in calibrating their national meteorological standards and related oceanographic monitoring instruments according to the RMIC capabilities;

(b) A RMIC must participate in, or organize, JCOMM and/or regional instrument intercomparisons, following relevant JCOMM recommendations;

(c) A RMIC must make a positive contribution to Members/Member States regarding the quality of measurements;

(d) A RMIC must advise Members/Member States on enquiries regarding instrument performance, maintenance and the availability of relevant guidance materials;

1: Basically in situ geo-physical instruments deployed in the surface marine environment or sub-surface
2: JCOMM will be the body that formally proposes new RMICs and proposes any authority to do evaluations

(e) A RMIC must actively participate, or assist, in the organization of regional workshops on meteorological and related oceanographic instruments and measurements;

(f) The RMIC must cooperate with other RMICs in the standardization of meteorological and related oceanographic measurements and sensors;

(g) A RMIC must regularly inform Members/Member States and report, on an annual basis, to the JCOMM Management Committee on the services offered to Members/Member States and the activities carried out. JCOMM in turn should keep the Executive Councils of the WMO and the UNESCO/IOC informed on the status and activities of the RMICs, and propose changes, as required.

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ANNEX VI

PROPOSED FORMAL ADOPTION PROCESS OF THE RMIC

According to the Terms of Reference of a RMIC, the mechanism for formal WMO and UNESCO/IOC designation of RMICs implies the following:

(a) Governance for defining the functions and adoption of an RMIC is proposed by JCOMM and endorsed by the WMO and UNESCO/IOC Executive Councils;
(b) A candidate RMIC is required to produce a statement of compliance, list capabilities of the proposed centre, state the suite of instrument expertise offered, state the formal commitment to voluntarily host the centre, and demonstrate capability to JCOMM.

The approach proposed by JCOMM is the following:

- The RMIC evaluates the extent to which it will be addressing the RMIC requirement in terms of capabilities and functions as described in the RMIC Terms of Reference.
- Once the candidate RMIC believes that it meets the requirements to a sufficient extend, its Director writes to the JCOMM Co-President to formally state the host commitment to voluntarily run and operate the RMIC on behalf of the WMO and IOC, and to request that the RMIC be listed in the list of RMICs through appropriate channels. In doing so, the candidate RMIC also provides for a statement of compliance in terms of RMIC capabilities and corresponding functions as described in the Annex of the RMIC Terms of Reference. The list of variables measured by specific instruments for which expertise will be offered as part of the RMIC activities is also provided. According to the ToR, an RMIC must apply international standards applicable for calibration laboratories, such as ISO/IEC 17025, to the extent possible. The Candidate RMIC will indicate to what extent it will meet these requirements. The letter should be copied to the Permanent Representative of the host country with the WMO, the IOC Action Addressee for the host country, the Secretary General of WMO, the Executive Secretary of IOC, and the President of the WMO Regional Association where the RMIC is located.
- Capability is also demonstrated by means of a training workshop on Marine instrumentation to be organized within 12 months of the request; resources should be committed by the host country for providing financial assistance to participants of developing countries in the region.
- As the JCOMM Observations Coordination Group (OCG) will be the primary advisory body for JCOMM regarding the RMICs, the JCOMM Co-President requests the OCG to evaluate and verify the capabilities of the proposed Centre.
- The OCG evaluates the request and advises whether the candidate RMIC should be endorsed. The OCG may wish to delegate this work to individuals and/or groups acting on its behalf (e.g. one of the component teams, depending on the nature of the proposed centre), but any advice and proposal to JCOMM should still be assessed by and come through the OCG. OCG will also conduct reviews of performance and capabilities at the required intervals.
- If endorsed by the OCG, and depending on timing, the latter makes an informed recommendation to the JCOMM Management Committee (MAN) or the JCOMM Co-Presidents (acting on behalf of the Commission) and invites them to provide further advice to the next JCOMM Session.
- If endorsed by MAN or the JCOMM Co-Presidents as appropriate, a recommendation is passed to the next JCOMM Session, or depending on timing directly to the WMO and IOC Executive Councils.
- If endorsed by the JCOMM Session or the JCOMM Co-Presidents as appropriate, a recommendation is passed to the WMO and IOC Executive Councils for including the candidate in the list of RMICs.

- If the JCOMM recommendations is approved by the WMO Executive Council, the candidate RMIC is listed in the WMO Publication No. 8 (CIMO Guide) and becomes a WMO RMIC;
- If the JCOMM recommendation is approved by the IOC Executive, the candidate becomes an IOC RMIC;
- If the JCOMM recommendation is approved by both WMO and IOC Executive Councils, the candidate becomes a joint WMO-IOC RMIC.

It is expected that this process, from submission of the RMIC proposal to the JCOMM co-president, to formal approval by either of both the WMO/IOC Executive Councils, may take from 6 to 12 months.

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ANNEX VII

PROPOSED STRATEGY FOR THE REVIEW OF THE WMO AND IOC TECHNICAL PUBLICATIONS IN LIGHT OF THE PILOT PROJECT DEVELOPMENTS

4.1 One of the goals of the JCOMM Pilot Project for WIGOS is to define methodology, governance between WMO and IOC partners, and test concept for agreeing on common standards for ocean observation practices (i.e. guidelines, best, mandatory or recommended practices, or minimum specifications as appropriate), including instruments and methods of observation as well as subsequent organization and handling of the data and information to deliver consistent and better quality data to both the broad user and modelling communities. Data records must be traceable to standards, i.e. thanks to collected instrument/platform metadata, it must be possible to identify what standards were used to make the measurements and perform quality monitoring. Maintenance and calibration are critical for ensuring stability and sustainability of systems. To understand system and component performance, a thorough documentation of observing platform siting and history as well as the recording and updating of metadata are critical in the elimination of inhomogeneities in data records.

4.2 The two domains of marine meteorology and oceanography have different histories that have resulted in different practices. For marine meteorology, there is a long history of working within the framework of the WMO and the various regulations and observing practices that have been established. Meanwhile, oceanographic observations are largely originated from research initiatives, during rather the recent period; new methods and procedures are frequently being developed, tested and applied to the regular observing activities. It is therefore important to develop and agree on the use of up-to-date standards and best (or minimal) practices.

4.3 It must also be noted that instrument practices, calibration procedures, operating / implementation / deployment procedures and guides, quality control procedures and / or guidelines (delayed-mode, real-time, automatic, or manual), data processing techniques, and formats (e.g., data collection formats) have been developed over the years by the different marine observing systems whose implementation is now coordinated through the JCOMM Observations Programme Area (OPA). The ocean observation Panels under OPA include the Data Buoy Co-operation Panel (DBCP), the Global Sea Level Observing System (GLOSS), the Ship Observations Team (SOT). The ocean observation Panels associated with OPA include the Ocean Sustained Interdisciplinary Timeseries Environment observation System (OceanSITES), the Argo Steering Group (AST), and the IOC International Ocean Carbon Coordination Project (IOCCP).

4.4 All these Panels are maintaining documentation on methods of observation, and there is benefit in reviewing the relevant information on instrumentation best (or minimal) practices and standards, addressing integration issues, i.e. identifying compatibilities, avoiding duplication of information, proposing higher levels of standards, including joint WMO-ISO standards. Documentation should be updated accordingly, higher level standards proposed and integrated into relevant parts of the appropriate WMO and / or IOC Manual and Guides, and appropriate cross-references made between the various documents. However, experimental or research observational methods shall not be considered in this exercise.

4.5 From a WMO perspective, and as part of the WIGOS framework, the agreed-upon standards and recommended practices, and procedures will apply to all WMO observing systems and Programmes. WMO will work with IOC to achieve maximum commonality of standards and practices across GOOS and GCOS. Strong cooperation and collaboration is therefore needed with IOC. The Twenty-fifth Session of the IOC Assembly, Paris, 16-25 June 2009, noted and endorsed as a priority to be considered by JCOMM-III the development of standards and best practices for operational ocean and marine meteorological data, products and services.

4.6 In this context, the purpose of promoting higher level standards is to review and update WMO and IOC Technical Publications in such a way to (i) facilitate cooperation amongst Members/Member States for the implementation of ocean observing systems and the making of

observations, (ii) specify obligations (for a Manual) or recommendations (for a Guide) of/to Members/Member States in addressing the requirements of WMO and IOC Programmes, and co-sponsored Programmes, and (iii) ensure adequate uniformity and standardization in the practices and procedures employed.

4.7 In the process of going towards higher level standards, the mandates of WMO and IOC will have to be respected, as well as the hierarchy of the documents (from characteristics of observing networks to instrument practices, and from standard practices to recommended practices). Duplication shall be avoided, and references made to other Publications as appropriate.

4.8 The review of such documentation has started as part of the development of the *JCOMM Catalogue of Best Practices and Standards* in early 2009 and some recommendations have already been made.

Existing Publications and References

4.9 The standards and practices used in observing the atmosphere and ocean need to be well documented and ensure that sufficient detail accompanies observations so that a user can interpret the measurements correctly.

4.10 Commonly agreed standards and best practices for observing ocean sub-surface and surface parameters were documented as IOC Manual and Guides No. 4 (Guide to Oceanographic and Marine Meteorological Instruments and Observing Practices), and IOC Manual and Guides No. 26 (Manual of Quality Control Procedures for Validation of Oceanographic Data). There are other publications addressing specific ocean variables or observing platform types, such as IOC Manual and Guide No. 14 for sea level data.

4.11 Observations for traditional ocean surface, atmospheric surface, and upper atmospheric parameters have basically been addressed and documented by the following WMO publications, including; (i) WMO Publication No. 544, Manual on the Global Observing System (GOS)[1], (ii) WMO Publication No. 488, Guide on the GOS[2], and (iii) the WMO Publications No. 8, Guide to Meteorological Instruments and Methods of Observation[3]. All three Publications contain marine sections or parts dedicated to ocean variables, or ocean observing platform types. The WMO Commission for Basic Systems (CBS) is responsible for updating WMO No. 544, and WMO No. 488. Proposed changes will have to be submitted to the CBS Rapporteur on Regulatory Material for review then to the CBS Implementation Coordination Team on Integrated Observing Systems (ICT-IOS), then to the CBS Session. The WMO Commission for Instruments and Methods of Observation (CIMO) is responsible for updating WMO No. 8 and proposed changes will have to be submitted through the Rapporteur on the CIMO Guide.

4.12 Both the IOC M&G No. 4 (published in 1975) and No. 26 (published in 1993) require update – during the IODE/JCOMM Forum on Oceanographic Data Management and Exchange Standards (Ostend, Belgium, 21-25 January 2008), participating experts reviewed large part of the M&G No. 26 where the concerned parameters were addressed (e.g. temperature/salinity profiles, sea level, surface waves), and agreed on the plan for update in short term.

4.13 Taking into account the limited resources available within JCOMM, updating this guide will be a long exercise. At the same time, one could consider doing this in conjunction with the updating of the WMO No. 544, WMO No. 488, and WMO No. 8. But the WMO Publications updating should be faster because they are more up to date. The WMO process should not be slowed down. So it is recommended to undertake the updating process of the WMO and IOC

1: The Manual on the GOS addresses standard practices and procedures that WMO Members have to follow. It essentially specifies what is to be observed, where and when in order to meet the relevant observational requirements of Members.
2: The guide on the GOS addresses recommended practices and procedures which it is desirable that Members follow or implement. It provides detailed guidance on how to establish, operate, and manage networks of stations to make these observations.
3: The Guide to Meteorological Instruments and Methods of Observation addresses recommended practices and procedures which it is desirable that Members follow or implement. It contains comprehensive and up to date guidance on the most effective practices for making meteorological observations and practices.

Publications in parallel at different speeds – with the ultimate goal to achieve common, complementary, or compatible standards - bearing in mind that the results will be delivered separately and with different time scales.

Proposal for near-term work

4.14 Based on the current situation, the following two-step approach is being proposed in order to properly integrate Instrument Methods of Observations of interest to JCOMM as part of the WMO and IOC Technical Publications.

(1) Step 1 – Agree on contents of WMO and IOC Publications according to the mandates of both Organizations;

(2) Step 2 – Seeking expertise within JCOMM, in cooperation with associated programmes, to effectively conduct the updating of relevant WMO and IOC Publications;

4.15 Step 1 – Agree on content of WMO and IOC Publications according to the mandates of both Organizations

4.15.1 The goal is to seek agreement on what should be included in each Publication in order to minimize duplication. WMO and IOC Publications should make references to each other. This approach should also simplify future updates. Table 1 is summarizing the variables of interest to JCOMM, which are addressed in IOC M&G No. 4, WMO No. 544, WMO No. 488, WMO No. 8, and IOC M&G No. 14. To reach agreement, the following principles could be proposed:

(i.) JCOMM would be focusing, at least initially, on the geo-physical sub-surface, and ocean/marine surface variables. So the atmospheric upper air variables can probably be left out of this exercise, and perhaps also the biological ones (WMO and IOC therefore addressing these two domains separately);

(ii.) The WMO Publications would probably continue to address what they have been addressing so far (i.e. the meteorological variables plus some usual surface marine variables);

(iii.) The WMO Publications would not specifically address the sub-surface variables, or platform types such as XBTs, and Argo; but references would be made to the IOC M&G provided these will indeed be documented;

(iv.) Some of the atmospheric variables can be addressed in the IOC M&G No. 4 but references should be made to the WMO Publications;

(v.) There are some variables (e.g. SST, SSS, waves, surface currents, sea level) that shall probably be addressed in both WMO and IOC Manual and Guides but one should make sure that there is some level of consistency between the two although they don't have to be identical as different applications might be targeted (applications targeted should be mentioned in that case).

Variable	IOC M&G No. 4	IOC M&G No. 26	WMO No. 8	WMO No. 544	WMO No. 488	IOC M&G No. 14
Ocean sub-surface						
Sub-T	X	X				
Sub-Sal	X	X				
Sub Currents	X	X				
Ocean Surface						
Surface-Currents	X	X				
Waves	X	X		X	X	
SST	X			X	X	
SSS	X					
Water transparency and colour	X					
Sea-Ice			X	X	X	
Sea level						X
Ship's course and speed				X	X	
Atmospheric Surface						
Air T	X		X	X	X	
Wind	X	X	X	X	X	
Air pressure (and tendency)	X		X	X	X	
Air humidity	X		X	X	X	
Precipitation	X		X	X		
Visibility	X		X	X	X	
Radiation			X	X		
Sunshine duration			X	X		
Present, past weather			X	X	X	
Clouds			X	X	X	
Ozone			X			
Atmospheric composition			X			
Special phenomena			X	X	X	
Upper Air						
Upper air P, T, U			X	X	X	
Upper wind			X	X	X	

Table 1: Variables of interest to JCOMM addressed in IOC Manual and Guides No. 4, IOC M&G No. 26, WMO No. 544, WMO No. 488, WMO No. 8, and IOC Manual and Guides No. 14 (JCOMM TR No. 31).

4.15.2 Based on those principles, one could for example propose initially to address some variables of interest to JCOMM as shows in Table 2 (in bold where the variable would be added in the corresponding Publication).

Variable	IOC M&G No. 4	IOC M&G No. 26	WMO No. 8	WMO No. 544	WMO No. 488
Ocean sub-surface					
Sub-T	X	X			
Sub-Sal	X	X			
Sub Currents	X	X			
Ocean Surface					
Surface-Currents	X	X	**X**	**X**	**X**
Waves	X	X	**X**	X	X
SST	X	**X**	**X**	X	X
SSS	X	**X**			
Water transparency and colour	X	**X**			
Sea-Ice			X	X	X
Sea level	**X**	**X**	**X**	**X**	**X**
pCO_2	X	**X**			
Atmospheric Surface					
Air Temperature	X	**X**	X	X	X
Wind speed and direction	X	X	X	X	X
Air pressure (and tendency)	X	**X**	X	X	X
Air humidity			X	X	X
Precipitation			X	X	
Visibility			X	X	X
Radiation			X	X	
Present and past weather			X	X	X
Clouds			X	X	X
Ozone			X		
Atmospheric CO_2 at the surface					
Special phenomena			X	X	X

Table 2: Variables of interest to JCOMM that could be addressed in future versions of IOC M&G No. 4, IOC M&G No. 26, WMO No. 544, WMO No. 488, and WMO No. 8.

4.16 Step 2 – Seeking expertise within JCOMM, coordinating with associated programmes, to effectively conduct the updating of relevant WMO and IOC Publications

Once agreement is reached regarding what shall be included in each Publication, some extensive consultation will be required within JCOMM and beyond in order to effectively conduct the review of the relevant WMO and IOC Publications. It is proposed to run the following activities in parallel:

(1) Working on an observed variable basis;
(2) Working on an observing platform type basis; and
(3) Addressing the more general issues.

4.16.1 Working on an observed variable basis

4.16.1.1 The strategy proposes to split the work for each variable, and develop a workplan accordingly. The workplan will be focusing initially on important ocean variables, or variables where it is believed it will be easier to reach consensus more quickly.

4.16.1.2 Some references are made below to the Community White Papers (CWP) submitted to the OceanOBS'09 symposium[4], Venice, 21-25 September 2009, and which are relevant to ocean instrument and methods of observation. It is recommended to consult with those experts during the course of this exercise.

4.16.1.3 The publications listed in Appendix A are also addressing methods of observation on a platform type basis and input from them can be used to address the variables below or address the platform-based sections of the WMO No. 544, WMO No. 488, and WMO No. 8:

a) Sea-level

Sea level instrument standards are well document in IOC M&G No. 14 (JCOMM TR No. 31), Manual on Sea Level Measurement and Interpretation - Volume IV: An Update to 2006, which is up to date. However, the guide is very detailed, and more general recommendations potentially acceptable to all Members/Member States will have to be extracted. Some information is also available in IOC M&G No. 26 but the publication should be updated.

The Global Sea Level Observing System (GLOSS) Group of Experts (GLOSS-GE) should be invited to address this issue and make recommendations for inclusion of appropriate information in the IOC M&G No. 4, and No. 26.

OceanOBS'09 Community White Papers:

- Bernard et al., Sustaining and integrating the tsunami observing networks
- Lafon et al., The SWOT (Surface Water Ocean Topography) Mission
- Merrifield et al., The Global Sea Level Observing System (GLOSS)
- Shum et al., Geodetic observations of ocean surface topography, ocean currents, ocean mass, and ocean volume changes
- Wilson et al., Ocean Surface Topography Virtual Constellation

b) Sea Surface Temperature (SST)

SST should be addressed by the Group on High Resolution SST (GHRSST) in collaboration with the Data Buoy Cooperation Panel (DBCP). Some work has already been initiated in this regard and should be pursued.

The following publications can also be used:

- DBCP No. 8, Guide to moored buoys
- DBCP No. 4, Barometer Drifter Design Reference
- IOC M&G No. 20, Guide to drifting data buoys (outdated)

OceanOBS'09 Community White Papers:

- Donlon et al., Successes and Challenges for the Modern SST Observing System
- Meldrum et al., Data buoy observations: the status quo and anticipated developments over the next decade

c) Waves

Waves should be addressed by the DBCP and the JCOMM Expert Team on Wind Waves and Storm Surges (ETWS). Some information is also available in IOC M&G No. 26 but the publication should be updated.

The following publications can also be used:

4: http://www.oceanobs09.net/

- WMO No. 702, Guide to Wave Analysis and Forecasting, 1998, second edition - Chapter 8
- JCOMM TR No. 9, Estimation of extreme wind wave heights
- IOC M&G No. 18, User Guide for the Exchange of Measured Wave Data

OceanOBS'09 Community White Papers:

- Swail et al., Wave measurements, needs and developments for the next decade

d) Surface currents

Surface currents should be addressed by the DBCP and OceanSITES. Some information is also available in IOC M&G No. 26 but the publication should be updated.

OceanOBS'09 Community White Papers:

- Lagerloef et al., Measuring the global ocean surface circulation with satellite and in situ observations
- Send et al., A global boundary current circulation observing network
- Shum et al., Geodetic observations of ocean surface topography, ocean currents, ocean mass, and ocean volume changes

e) Sea-ice

Sea-ice should be addressed by the JCOMM Expert Team on Sea-Ice (ETSI), the International Arctic Buoy Programme (IABP), and the WCRP-SCAR International Programme for Antarctic Buoys (IPAB).

The following publications can also be used:

- JCOMM TR No. 8, Oceanographic and Marine Meteorological Observations in the Polar Regions – A report to JCOMM
- WMO No. 259, WMO sea-ice nomenclature
- Electronic chart Systems Ice Object catalogue

OceanOBS'09 Community White Papers:

- Breivik et al., Remote sensing of sea ice
- Lee et al, The Ocean and Sea-Ice Components of the Arctic Observing Network
- Calder et al., An Integrated International Approach to Arctic Ocean Observations for Society (A Legacy of the International Polar Year)

f) Sub surface water temperate, and salinity

Sub-surface water temperature and salinity should be addressed by the Argo Steering Team (AST), the Ship Of Opportunity Programme (SOOPIP), and the Tropical Moored Buoy Implementation Panel (TIP). Some information is also available in IOC M&G No. 26 but the publication should be updated.

The following publications can also be used:

- SOOPIP XBT Best Practices
- SOOPIP XBT/XCTD Standard Test Procedures
- SOOPIP QC Cookbook for XBT data
- Procedures used at AOML to QC real time XBT data collected in the Atlantic Ocean
- IOC M&G No. 22, GTSPP real-time QC manual

OceanOBS'09 Community White Papers:

- Goni et al., Ship Of Opportunity Program
- McPhaden et al., The Global Tropical Moored Buoy Array
- Roemmich et al., Argo: Observing the global ocean

g) Sub surface Currents

JCOMM should consult with Acoustic Doppler Current Profiler (ADCP) experts in order to take this variable into account. Some information is also available in IOC M&G No. 26 but the publication should be updated. The International Ocean Carbon Coordination Project (IOCCP) is currently conducting a review of the Hydrography Manual which includes a chapter on WOCE ADCP as well as a chapter on acquiring Lowered Doppler Current Profiler Data.

h) Sea Surface Salinity (SSS)

SSS should be addressed by the IODE/JCOMM Global Ocean Surface Underway Data Pilot Project (GOSUD).

The following publications can also be used:

- SOOPIP User Guide for Thermosalinographs (TSG) installation and maintenance
- IOC M&G No. 44, Algorithms for the Computation of Fundamental Properties of Seawater
- WOCE Sea Surface Salinity user's manual

OceanOBS'09 Community White Papers:

- Lagerloef et al., Resolving the global surface salinity field and variations by blending satellite and *in situ* observations

i) Water transparency and colour

JCOMM should consult with Ocean Color experts in order to take this variable into account.

OceanOBS'09 Community White Papers:

- Yoder et al., The Ocean Colour Radiance Virtual Constellation (OCR-VC)

j) Ocean Carbon (pCO_2)

Ocean Carbon should be considered by the International Ocean Carbon Coordination Project (IOCCP).

OceanOBS'09 Community White Papers:

- Byrne et al., Sensors and Systems for Observations of Marine CO2 System Variables
- Schuster et al., A global sea surface carbon observing system: assessment of sea surface CO2 and air-sea CO2 fluxes

k) Surface atmospheric variables

Recommended practices for the following surface atmospheric variables are documented in the WMO No. 544, WMO No. 488, WMO No. 8, and WMO No. 471. A review of these Publications for those variables can be undertaken by a small group including representatives from the SOT, the DBCP, the TIP, and the OceanSITES.

- Air Temperature

- Wind speed and direction
- Air pressure (and tendency)
- Air humidity
- Precipitation
- Visibility
- Radiation
- Ozone
- Atmospheric CO_2 at the surface

In conducting this exercise, the group shall also propose to move relevant parts of Chapter 6 (the Voluntary Observing Ships' Scheme) of WMO Publication No. 471, Guide to marine meteorological services into the following Publications:

- WMO Publication No. 544, Manual on the Global Observing System (GOS)
- WMO Publication No. 488, Guide on the Global Observing System (GOS)
- WMO Publications No. 8, Guide to Meteorological Instruments and Methods of Observation

The following publications can also be reviewed:

- DBCP No. 4, Barometer Driver Design Reference
- DBCP No. 8: Guide to Moored Buoys and Ocean Data Acquisition Systems
- JCOMM TR No. 4, The Voluntary Observing Ships Scheme – A Framework Document - Revision 1
- JCOMM TR No. 5, Voluntary Observing Ships (VOS Climate Subset Project (VOSCLIM) – Project Document
- SOR Basic ship visit and rider rules
- Tropical Moored Buoy array publications

OceanOBS'09 Community White Papers:

- Meldrum et al., Data buoy observations: the status quo and anticipated developments over the next decade
- Kent et al., The Voluntary Observing Ship Scheme
- Send et al., OceanSITES

r) Present and past weather

This variable can only realistically be manually observed in the marine environment from ships or sea stations. Unless new requirements arise, or new technology is proposed, it is not proposed to update the WMO Manuals and Guides No. 544, 488, 8, and 471 at this point.

s) Clouds

This variable can only realistically be manually observed in the marine environment from ships or sea stations. Unless new requirements arise, or new technology is proposed, it is not proposed to update the WMO Manuals and Guides No. 544, 488, 8, and 471 at this point.

v) Special phenomena

This variable can only realistically be manually observed in the marine environment from ships or sea stations. Unless new requirements arise, or new technology is proposed, it is not proposed to update the WMO Manuals and Guides No. 544, 488, 8, and 471 at this point.

4.16.1.4 Table 3 below provides for a summary of variables to address, and groups to be involved, Publications to review, and OceanOBS'09 experts to consult.

Variable	Group(s) to consult	Publication to use	OceanOBS'09 CWP
Sea level	GLOSS-GE	IOC M&G No. 14 IOC M&G No. 26	Bernard et al., Lafon et al., Merrifield et al., Shum et al., Wilson et al.
SST	GHRSST, DBCP	DBCP No. 4 DBCP No. 8 IOC M&G No. 20	Donlon et al., Meldrum et al.
Waves	ETWS, DBCP	IOC M&G No. 26 JCOMM TR No. 9 IOC M&G No. 18 WMO No. 702	Swail et al.
Surface current	DBCP, OceanSITES	DBCP No. 8 IOC M&G No. 20 IOC M&G No. 26	Lagerloef et al., Send et al., Shum et al.
Sea-ice	ETSI, IABP, IPAB	JCOMM TR No. 8 WMO No. 259 Electronic chart Systems Ice Object catalogue	Breivik et al., Lee et al, Calder et al.
Sub-surface temperature and salinity	AST, SOOPIP, TIP	SOOPIP XBT Best Practices SOOPIP XBT/XCTD Standard Test Procedures SOOPIP QC Cookbook for XBT data Procedures used at AOML to QC real time XBT data collected in the Atlantic Ocean IOC M&G No. 22 IOC M&G No. 26	Goni et al., McPhaden et al., Roemmich et al.
Surface currents	ADCP experts	IOC M&G No. 26 IOCCP Hydrography Manual	
SSS	GOSUD	SOOPIP User Guide for Thermosalinographs (TSG) installation and maintenance IOC M&G No. 44 WOCE Sea Surface Salinity user's manual	Lagerloef et al.
Ocean color	Ocean color experts		Yoder et al.
Ocean carbon	IOCCP		Byrne et al., Schuster et al.
Surface atmospheric variables	SOT, DBCP, TIP, OceanSITES	WMO No. 8 WMO No. 544 WMO No. 471 DBCP No. 4 DBCP No. 8 JCOMM TR No. 4 JCOMM TR No. 5 SOT Basic ship visit and rider rules Tropical moored buoy array publications	Meldrum et al., Kent et al., Send et al.

Table 3: Summary of variables to address, and groups to be involved, Publications to review, and OceanOBS'09 experts to consult.

4.16.2 Working on an observing platform type basis

4.16.2.1 It is proposed to focus initially on the following types of ocean observing platforms. As JCOMM Panels are platform based, the relevant ones should be at least consulted for reviewing IOC M&G No. 4, WMO No. 544, 488, 8 and providing input as required. Other associated programmes should be consulted as appropriate.

Platform type	**Panel**
Drifters	DBCP
Moored buoys	DBCP, OceanSITES, TIP
Ships	SOT, IOCCP
Profiling floats	AST
Tide gauges	GLOSS
Tsunameters	ITP

Table 4: Platform types and ocean observations Panel to consult.

4.16.2.2 It is proposed to recruit a consultant who would consult with these Panels, and suggest changes to the Publications. These changes would then be reviewed by each Panel, hopefully endorsed, and then submitted to the appropriate WMO and IOC bodies.

4.16.3 Addressing the more general issues

4.16.3.1 A task team designated by the JCOMM Observations Coordination Group (OCG) shall be responsible for reviewing the general sections of the following Publications, consulting other expert groups, and providing input as appropriate:

- IOC Manual and Guides No. 4, Guide to Oceanographic and Marine Meteorological Instruments and Observing Practices
- IOC Manual and Guides No. 26, Manual of Quality Control Procedures for Validation of Oceanographic Data
- WMO Publication No. 544, Manual on the Global Observing System (GOS)
- WMO Publication No. 488, Guide on the Global Observing System (GOS)
- WMO Publications No. 8, Guide to Meteorological Instruments and Methods of Observation

4.16.3.2 The Task Team shall then submit its recommendations for updating the above Publications to the WMO and IOC Executive Councils through JCOMM for approval.

4.17 Summary of recommendations

4.17.1 Work required is ambitious, and resources limited. Things will therefore have to be prioritized, and achieved in several steps in the next few years. A workplan, focusing initially on priority ocean variables/platform types, or where we believe it will be easier to reach consensus more quickly will have to be proposed. To execute the workplan, the following is proposed:

- Specific Task Teams (TT) to address what observing platform types are the most appropriate for observing specific ocean variables, and for the standardization of instruments and methods of observation for these variables (one Task Team for one or more variables).
- A Consultant to work on an observing platform type basis (one consultant for one or more platform types).
- An OCG Task Team on standardization of ocean observations to look at the more general issues.

4.17.2 Each Task Team and the consultant will have to consult each other, as well as experts who have submitted appropriate Community White Paper (CWP) to the OceanOBS'09 symposium. They will also have to review and extract appropriate information from existing JCOMM Publications or documents addressing observing networks, observing platform types, instrument

issues and methods of observation. Generic Terms of Reference for the Task Teams and the consultant are proposed in Appendix B.

4.17.3 In this process, the mandates of WMO and IOC will have to be considered, as well as the hierarchy of the documents (from characteristics of observing networks to instrument practices, and from standard practices to recommended practices). Duplication shall be avoided, and references made to other Publications as appropriate. Standard or recommended best (or minimal) practices and procedures concerning Observing Systems, methods of observations, and instruments shall be made sufficiently generic and potentially acceptable to all WMO Members and IOC Member States. They shall properly translate the requirements of WMO and IOC Programmes and co-sponsored Programmes in terms of observing systems characteristics, platform type typical configurations, essential instrument features, and methods of observation. Recommendations shall be limited to the generally accepted common characteristics of observing networks or existing configurations. Some of the technical details will therefore be avoided in order to limit the documentation's dependency vis a vis existing technology, or to avoid hindering technological advances. Similarly, experimental or research observational methods shall not be considered in this exercise.

4.17.4 The work will have to be conducted according to the WMO and IOC regulation cycle (typically four years), and can be repeated as long as there is a need to review and update the documentation (Table 5). However, the cycle proposed in Table 5 is just given as an example of how things could be developed. In other words, one shall not necessarily have to wait for the end of a cycle to start working on other variables or platform types; work can also be done in parallel if possible.

Time ⟶ …			
Cycle 1 (4 years)		**Cycle 2 (4 years)**	
TT for variable a TT for variable b Consultant for platform type α Consultant for platform type β TT for general issues	Changes proposed to WMO & IOC bodies	TT for variable c TT for variable d Consultant for platform type γ Consultant for platform type δ TT for general issues	Changes proposed to WMO & IOC bodies

Table 5: Regulatory cycle

4.17.5 In the context of the JCOMM Pilot Project for WIGOS, and to prove concept, it is proposed to start the first cycle with the following:

- Variables: SST, and/or surface meteorological variables (one or two Task Teams)
- Platform types: drifters, moored buoys (one consultant)
- General issues (one Task Team)

4.17.6 It is proposed to invite the Data Buoy Cooperation Panel (DBCP) to consider supporting this work through financially supporting the consultant. The twenty-fifth Session of the DBCP (Paris, France, 28 September – 1 October 2009) discussed this issue and agreed to commit resources in support of this exercise. With the acceptance of this proposal, the OCG will be invited to establish the Task Teams.

4.17.7 With progress through this proposed work, changes and updates proposed for WMO No. 544 and WMO No. 488 will be submitted to the CBS Rapporteur on Regulatory Material (Alexander Vasiliev, Russian Federation), for review before March 2010 in order for such changes to be considered by the CBS Implementation Coordination Team on Integrated Observing Systems (ICT-IOS) (Sept. 2010) and approved by the CBS in 2011. Changes proposed for WMO No. 8 will have to be submitted through the Rapporteur on the CIMO Guide.

APPENDIX A (OF ANNEX VII)

PUBLICATIONS OF INTEREST

No.	Title	URL
WMO No. 8	Guide to Meteorological Instruments and Methods of Observation (CIMO Guide)	http://www.wmo.int/pages/prog/www/IMOP/publications/CIMO-Guide/CIMO_Guide-7th_Edition-2008.html
WMO No. 259	WMO sea-ice nomenclature	http://www.aari.nw.ru/gdsidb/XML/sea_ice_nomenclature.html
WMO No. No. 471	Guide to marine meteorological services (regulates the Voluntary Observing Ship Scheme)	
WMO No. 488	Guide on the Global Observing System (GOS)	ftp://ftp.wmo.int/Documents/MediaPublic/Publications/WMO488_GOSguide/488_Guide_2007.pdf
WMO No. 544	Manual on the Global Observing System (GOS)	http://www.wmo.int/pages/prog/www/OSY/Manuals_GOS.html
WMO No. 702	WMO No. 702, Guide to Wave Analysis and Forecasting, 1998, second edition - Chapter 8	http://www.wmo.int/pages/prog/amp/mmop/documents/WMO%20No%20702/WMO702.pdf
IOC M&G No. 4	Guide to oceanographic and marine meteorological instruments and observing practices	http://unesdoc.unesco.org/images/0005/000599/059947eo.pdf
IOC M&G No. 14	Manual on Sea Level Measurement and Interpretation - Volume IV: An Update to 2006	ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-TR/J-TR-31/JCOMM-TD-31.pdf
IOC M&G No. 18	User Guide for the Exchange of Measured Wave Data	http://unesdoc.unesco.org/images/0007/000785/078593eb.pdf
IOC M&G No. 20	Guide to drifting data buoys (outdated)	http://unesdoc.unesco.org/images/0008/000813/081353eo.pdf
IOC M&G No. 22	GTSPP real-time QC manual	http://unesdoc.unesco.org/images/0008/000878/087850eb.pdf
IOC M&G No. 26	Manual of Quality Control Procedures for Validation of Oceanographic Data	http://unesdoc.unesco.org/images/0013/001388/138825eo.pdf
IOC M&G No. 44	Algorithms for the Computation of Fundamental Properties of Seawater	http://unesdoc.unesco.org/images/0005/000598/059832eb.pdf
JCOMM TR No. 4	The VOS Ships Scheme, a framework document – Revision 1	ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-TR/J-TR-4-VOS-Framework-Document/JCOMM-TR-4-VOS-Framework-Document-REV1.pdf
JCOMM TR No. 5	Voluntary Observing Ships (VOS) Climate Subset Project (VOSCLIM) – Project Document, Revision 2	http://www.jodc.go.jp/info/ioc_doc/JCOMM_Tech/TR05_2_VOS_Rev2.pdf
JCOMM TR No. 8	Oceanographic and Marine Meteorological Observations in the Polar Regions - A Report to JCOMM	ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-TR/J-TR-8-Holland-Report/JCOMM-TR-8.doc
JCOMM TR No. 9	Estimation of extreme wind wave heights	http://www.jodc.go.jp/info/ioc_doc/JCOMM_Tech/TR09.pdf
DBCP No. 4	Barometer Driver Design Reference	http://www.jcommops.org/doc/DBCP/svpb_design_manual.pdf
DBCP No. 8	Guide to Moored Buoys and Ocean Data Acquisition Systems	
	SOT Basic ship visit and rider rules	http://www.jcommops.org/soopip/soopog-ship-visit.html
	SOOPIP XBT Best Practices	http://www.jcommops.org/soopip/doc/manuals/best_guide/SOOP_best_guide.pdf
	SOOPIP XBT/XCTD Standard Test Procedures	http://www.jcommops.org/soopip/doc/manuals/soopog/XBT-XCTD-

		standard-test-procedures.doc
	SOOPIP QC Cookbook for XBT data	http://woce.nodc.noaa.gov/woce_v3/wocedata_1/woce-uot/document/qcmans/csiro/csiro.htm
	SOOPIP User Guide for Thermosalinographs (TSG) installation and maintenance	http://www.legos.obs-mip.fr/en/observations/sss/publications/others/rapports_en_pdf/TSG_Guide_UK.pdf
	Procedures used at AOML to QC real time XBT data collected in the Atlantic Ocean	http://woce.nodc.noaa.gov/woce_v3/wocedata_1/woce-uot/document/qcmans/aoml/aoml_1.htm
	Tropical moored buoy array publications	http://www.pmel.noaa.gov/tao/proj_over/proj_over.html
	Electronic chart Systems Ice Object catalogue	http://www.jcomm-services.org/modules/documents/documents/si3_gdsidb11_Doc_2.6.4_Appendix_Ice_Objects_Catalogue.doc
	WOCE Sea Surface Salinity user's manual	http://www.ifremer.fr/gosud/doc/cordo-mut-02-047.doc

APPENDIX B (OF ANNEX VII)

PROPOSED GENERIC TERMS OF REFERENCE OF THE TASK TEAMS AND THE CONSULTANT

1) Generic Terms of Reference of a Task Team on standardization of ocean "Variable V" measurements

The Task Team shall:

(a) Review ocean observation practices concerning ocean variable "V" as documented in IOC M&G No. 4, WMO No. 544, WMO No. 488, and WMO No. 8;
(b) Review other documentation produced by JCOMM observations Panels and associated programmes and relevant to the measurement of ocean variable "V";
(c) Consult with JCOMM experts from those groups as appropriate;
(d) Consult with relevant OceanOBS'09 experts;
(e) Propose revisions, as appropriate, to IOC M&G No. 4, WMO No. 544, WMO No. 488, and WMO No. 8 in the view to (i) facilitate cooperation amongst Members/Member States for the implementation of ocean observing systems routinely measuring ocean variable "V", (ii) specify obligations (for a Manual) or recommendations (for a Guide) of/to Members/Member States in addressing the requirements of WMO and IOC Programmes, and co-sponsored Programmes requiring routine observations of ocean variable "V", and (iii) ensure adequate uniformity and standardization in the practices and procedures employed;
(f) Report to the JCOMM Observations Coordination Group.

Members of the Task Team will be appointed by the Observations Coordination Group with relevant experts from JCOMM observations panels, associated programmes, and beyond.

2) Terms of Reference of the Task Team on standardization of ocean observations

(a) Review the sections of IOC M&G No. 4, WMO No. 544, WMO No. 488, and WMO No. 8 concerning ocean observation practices that are not specific to any ocean variable;
(b) Review other relevant documentation produced by JCOMM observations Panels and associated programmes;
(c) Consult with JCOMM experts from those groups as appropriate;
(d) Propose revisions, as appropriate, additions, or deletion to the sections of IOC M&G No. 4, WMO No. 544, WMO No. 488, and WMO No. 8 that are no specific to any ocean variable in the view to (i) facilitate cooperation amongst Members/Member States for the implementation of ocean observing systems and the making of observations, (ii) specify obligations (for a Manual) or recommendations (for a Guide) of/to Members/Member States in addressing the requirements of WMO and IOC Programmes, and co-sponsored Programmes, and (iii) ensure adequate uniformity and standardization in the practices and procedures employed;
(e) Report to the JCOMM Observations Coordination Group.

Members of the Task Team will be appointed by the Observations Coordination Group with relevant experts from JCOMM observations panels, associated programmes, and beyond.

3) Terms of Reference of the Consultant on a Platform Type "P"

The consultant shall:

(a) Review ocean observation practices concerning Platform type "P" as documented in IOC M&G No. 4, WMO No. 544, WMO No. 488, and WMO No. 8;
(b) Review other documentation produced by JCOMM observations Panels and associated programmes and relevant to Platform Type "P";

(c) Consult with JCOMM experts from those groups as appropriate;
(d) Consult with relevant OceanOBS'09 experts;
(e) Propose revisions, as appropriate, to IOC M&G No. 4, WMO No. 544, WMO No. 488, and WMO No. 8 in the view to (i) facilitate cooperation amongst Members/Member States for the implementation of Platform Type "P", (ii) specify obligations (for a Manual) or recommendations (for a Guide) of/to Members/Member States in addressing the requirements of WMO and IOC Programmes, and co-sponsored Programmes requiring deployment and operations of Platform Type "P", and (iii) ensure adequate uniformity and standardization in the practices and procedures employed;
(f) Report to the JCOMM Observations Coordination Group.

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ANNEX VIII

STRENGTHS AND WEAKNESSES OF THE CURRENT GOVERNANCE FRAMEWORK IN THE MANAGEMENT OF THE OCEAN OBSERVING SYSTEMS

Tables 1 and 2 below provide for (1) the strengths, and (2) the weaknesses in the management of the ocean observing systems respectively.

Table 1: Strengths in the management of the ocean observing systems

Strengths	Comment
Implementation, coordination	
Good governance through JCOMM for the implementation of ocean observing systems (DBCP, SOT, GLOSS, Argo, OceanSITES)	Those mechanisms should be maintained and strengthened
Good implementation support through JCOMMOPS	JCOMMOPS should be strengthened
Good cooperation between research and operational agencies developed through JCOMM Panels	This facilitates the sharing of the data, including in real-time. JCOMM Panels must remain open to participation from research and operational agencies
Instruments and methods of observation	
Standards exist for meteorological instruments	Review and updating ongoing through JCOMM, CBS, and CIMO
Reliable instrumentation and technology	Technology developed thanks to strong links with the research partners and the private sector through the JCOMM observations panels and associated programmes
Scientific programmes provide for high quality observations	The Research community should feed into the development of instrument practices; some mechanisms might have to be proposed to realize this (e.g. Argo, OceanSITES)
Data collection and data processing	
Appropriate data collection and location systems available (e.g. Argos, Iridium, Inmarsat, DCP)	Satellite operators participate in JCOMM activities through DBCP, and SOT.
Integrated GTS data processing system for the drifter data (through Service Argos)	This provides for more coherent/homogeneous data especially in terms of (i) automatic real-time data quality control, (ii) platform location and quality, and (iii) exchange formats. Some guidelines could be developed under JCOMM.
Well defined data processing procedures for the VOS scheme, including for delayed mode data	This is documented in the WMO Guide on Marine Meteorological Services – WMO No. 471 – and the VOS Scheme framework document. This provides for more coherent/homogeneous data
Data exchange	
Open data policies are promoted by WMO and IOC (WMO Res. 40 – Cg-XII – and IOC Oceanographic Data Exchange Policy – Resolution IOC-XXII-6)	These must be communicated to platform operators through JCOMM observations panels and associated programmes
Good data distribution infrastructure and regulations through the GTS and WIS	Migration to Table Driven Codes should be completed ASAP and no later than 2012
Long term archives	
Archiving centres in place (e.g. RNDODC/DB, GDACs)	The issue of the duplication between the IODE RNODC/DB and the JCOMM SOC/DB remains to be

	solved and addressed by both JCOMM and IODE
Quality monitoring	
Some efficient guidelines in place for some programmes (DBCP, SOT, Argo)	Updating process ongoing; this can eventually feed into higher level standards (WMO and IOC Manuals and Guides)

Table 2: Weaknesses in the management of the ocean observing systems

Weaknesses	**Comment**
Implementation, coordination	
Sustainability of funding remains an issue for some components largely funded by Research	Partnership between operational and research agencies should be strengthened
Gaps and data sparse areas	JCOMM is contributing to the Rolling Review of Requirements, and resulting recommendations must be communicated to platform operators when looking for funding nationally
Integration between *in situ* and satellite observations	Complementarity of *in situ* and satellite observations must be stressed and documented (e.g. assimilation, calibration, validation, bias correction, mixed *in situ*/satellite products, quality information feedback)
Instruments and methods of observation	
IOC instrument standards (e.g. M&G No. 4, No. 26) are not up to date	Review of the IOC M&G should be made
Lack of instrument/platform metadata	Some mechanisms are in place but are not used; Members must be convinced to commit resources for the routine provision of metadata to international archives so more communication is needed; assistance from the manufacturers through HMEI can help.
Traceability to standards is poor	Instrument intercomparisons are needed; this can be realized through the RMICs; metadata are needed (see above)
Instrument standards are not always used or not necessarily homogeneous between different observational components. In some cases, the standards used are not known.	More communication is needed to inform Members about requirements and guidelines, convince them to use appropriate standards, and provide information about the standards they actually use.
Data collection and data processing	
Relatively high cost of satellite data telecommunication (Argos, Inmarsat) remains an issue for platform operators	The use of cheaper satellite data telecommunication systems should be promoted; some forum could assist in this regard (see below).
Data timeliness is poor in certain areas	Users must address the issue and negotiate with satellite operators through appropriate channels (e.g. DBCP); some new forum could assist in this regard (see below).
There is an increasing number of different types of satellite data telecommunication systems being used, and a lack of coordination or standardization for the data processing of some platform data (e.g. buoy data in case other systems than Argos are used)	Some basic guidelines need to be developed. An international forum, recognized by the WMO and IOC, for the satellite data telecommunication users should be established and tasked to develop guidelines, negotiate tariff issues with the satellite operators, and address user requirements.

Data exchange	
Lack of interoperability between different data systems and ODP and/or WIS	ODP and WIS should be made interoperable; Members should be encouraged to develop interoperability between the ocean data systems they operate and the ODP and/or WIS.
There are still cases where a scientist wants to publish before willing to release the data (in other cases it is claimed that the data are not of sufficient quality)	Some communication strategy, and informational materials must be developed to explain rationale for data exchange, including the benefits to data providers (e.g. quality monitoring)
Long term archives	
Lack of interoperability between archiving centres and ODP and/or WIS	Members should be encouraged to develop interoperability between the ocean archiving centres they operate and the ODP and/or WIS
Members are not always submitting the data to the long term archives	Members should be encouraged to submit the data to the long term archives; more communication is needed and the benefits explained.
Quality monitoring	
The quality control procedures used for some data which are made available to the international community are not always known	There is a need to better document the quality control procedures for some of the observing components
The quality control guidelines are not always consistent to each other between different observing components	The is a need to review WMO and IOC related Ttechnical Publications and propose higher level standards

ANNEX IX

OVERVIEW OF THE CURRENT STATUS OF THE IODE OCEAN DATA PORTAL (ODP)

The ODP v1 architecture is based on the “client-server with mediator and wrappers” concept, sometimes known as “virtual data holdings or virtual organizations” (Fig.1.):

- Data Provider (wrapper) provides access to data and metadata of the local data systems. When the wrapper is installed in the local data system, the latter becomes a data source for the distributed data system.
- Integration Server (mediator) provides registration and operation status monitoring of the distributed data sources, harvesting of the discovery metadata in coordination with Data Provider, management of the common codes/dictionaries and access to distributed data sources by ODP services.
- ODP Services provides administration, discovery, viewing, analysis and download including a GIS-based user interface, metadata and data search, data download and visualisation components.

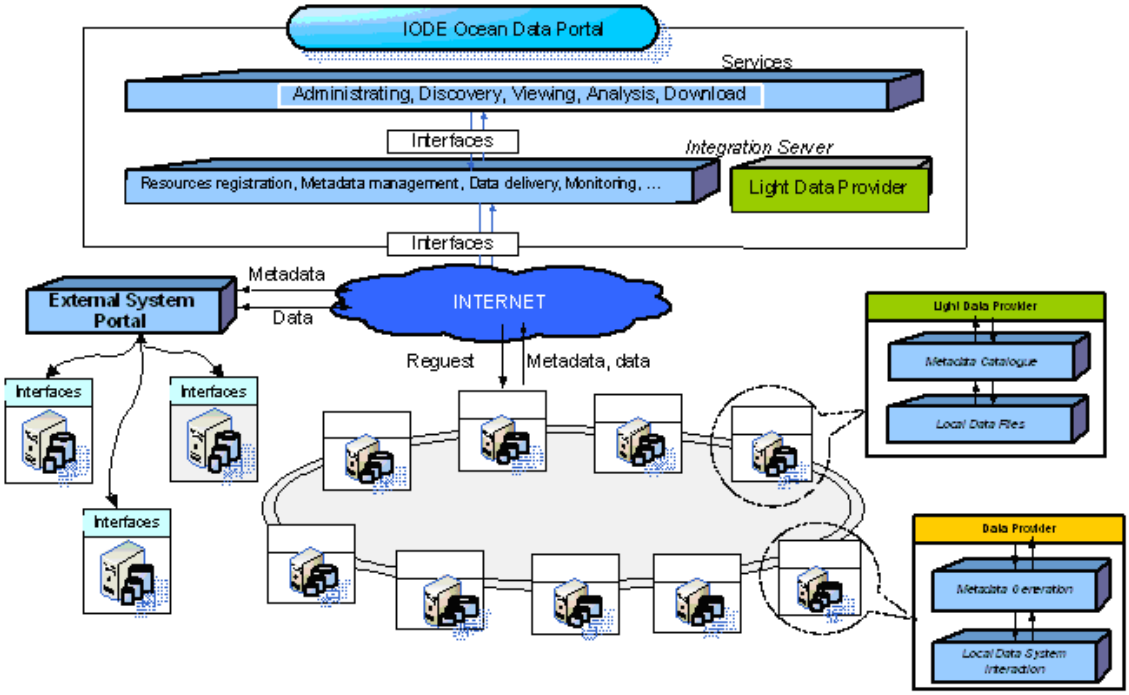

Fig.1. Overall architecture of the ODP v1

The Data Provider (v 1.5):

- can be installed at, and used from, any ODP node (in case of LDP the IODE Project Office is recommended);
- supports several remote data sources with data catalogues;
- supports ISO 19115 profiles (CDI is already supported, WMO Core and MCP are under development);
- plain ASCII format and CSV (also using the file name if contains spatial and temporal data characteristics in it for metadata);
- connects to the data files located on FTP.

The Integration Server (v.1.2) provides the following new functionality:

- Metadata conversion from End-to-End (E2E) to ISO 19115 (WMO Core, CDI);
- Statistics about requests on data;
- Monitoring of thematic federations;
- Data delivery as ASCII and NetCDF;

- Patterns creation on requests (scheduled data delivery);
- Data delivery ("push") on FTP;
- BODC parameter dictionary support.

During the Pilot Project, the Data Provider, Integration Server and ODP services were improved and expanded to include new functionality. In addition, the web-service communication between Integration Server and Data Provider were developed.

Light Data Provider

The Light Data Provider software is a recent extension of the Data Provider functionality which offers remote registration of local datasets and allows deployment of the ODP system without the need to install software by the Data Provider.

The Light Data Provider provides a different approach to managing catalogues of data and metadata including:

- Creation by the Data Provider of a remote directory with data, metadata based on the content of data files. Metadata can be in different formats, such as E2ESearchMD, Common Data Index (CDI), Marine Community Profile (MCP) or WMO Core, and loaded to the Data Provider;
- Creation of a remote directory with data and no metadata;
- Creation of a remote directory with object files which have metadata in filenames.

The Web-service of the Integration Server and Data Provider communication

Communication between Integration Server and Data Provider was improved by web-service creation which provides existing request-response communication with fault-tolerant processing and error catch, recognition and logging. Communication consists of two processes:

(i) Metadata harvesting by the Integration Server from the Data Providers. These resource descriptions are exposed to a harvester, which is part of the Integration Server. This software will regularly (at any set frequency) check all data centres for new resource descriptions and download these as necessary. These descriptions are added to a central repository that covers all data centres connected to the distributed system.

(ii) Request on data. Requests are transmitted by HTTP in encoded form. HTTP-connection between the Integration Server and Data Provider are active during processsing and the Data Provider requests acceptance, validation, execution and response return. Communication based on web-services provides transactional and fault-tolerant mode. If errors occur the Integration Server will immediatelly receive a message with an error code and description and all errors will be published by the specific web-service by means of *mostError* method. If a request for data was executed successfully the Data Provider will invoke *postResult* method with a response-message in the transport protocol structure.

The ODP website and services

The Ocean Data Portal website (www.oceandataportal.org) provides:

- Basic information for general users (e.g. how does ODP work, how to find data, who are the data providers, etc.);
- Technical information (Data Provider software distributable, manuals and documentation, services, formats and dictionaries);
- Discussion forum, FAQ and training materials;

ODP Services (data.oceandataportal.org) provide administration, discovery, viewing, analysis and download. The ODP includes a GIS-based user interface, metadata and data search, data download and visualization components. The ODP services include a number of W3C and OGC web-services:

Discovery service disseminates a data source catalogue with descriptions of resources in the form of XML files. The metadata record is based on ISO 19115. The ODP service provides user interfaces for data and product search supported by the catalogue. The data source catalogue can be accessed from external systems directly or alternatively by reformatting into other metadata structures.

Viewing service is based on web-based applications accessible via the web browser. The services provided include:

- data search that defines the sampling criteria using a spatial region, time period, phenomena, platform, etc.
- access to remote data sources via the Integration Server including request status monitoring; and
- processing of transport data files and tabular-graphic and map visualization of data using standard forms.

Analysis service has been developed to provide near real-time GIS-layer generation from distributed datasets both with interactive and fast presentation of multidisciplinary data and products on a map. It also includes Web Map Services (WMS) and Web Feature Service (WFS). The user can adjust the composition of the map layers, the number of maps for viewing and other specifications. The mapping service enables a joint analysis of data to provide a view of the spatial variability of marine processes.

Download service allows the user to download selected data to the local computer after viewing. If time scheduling is required to download data, the user can register the site for downloading, the list of required datasets and the sampling criteria. The transport data file formats that are available are:

- NetCDF (E2E convention)
- ASCII
- XML

Selected data can be either downloaded in a single zip-file or viewed using the ODP result viewing service.

Capacity Building

During 2009 three training courses for ODP distributed data system establishment were provided.

- The *Training Course on the Establishment of National Ocean Data Portal Nodes in the Black Sea Region (ODINBlackSea)* was held from 20-21 March 2009 in Obninsk, Russian Federation. Five ocean data centres from Bulgaria, Romania, Russia and Ukraine participated in the course. As a follow-up to the course, in April 2009, five institutions of the ODINBlackSea group joined as IODE Ocean Data Portal data providers: Bulgarian National Oceanographic Data Centre (BGODC/IO-BAS), Institute of Biology of the Southern Seas National Academy of Sciences of Ukraine (IBSS), Marine Hydrophysical Institute National Academy of Sciences of Ukraine (MHI), National Institute for Marine Research and Development (NODEC/NIMRD) and All-Russia Research Institute of Hydrometeorological Information - World Data Centre (RIHMI-WDC).

- The *First IOC WESTPAC Training Course on the Establishment of National IODE Ocean Data Portal Nodes* was held from 31 August - 4 September 2009 in Seoul, Republic of Korea. There were 10 participants from Republic of Korea, Japan, Malaysia, Thailand, Indonesia and Vietnam. During the training course each participant installed Data Provider software and created 3-5 information resources (metadata records). A small local training federation with Integration Server and 10 Data Provider was tested. Results were viewed through the local version of Ocean Data Portal user interface. Participants expressed their interest in contributing to the IODE ODP. Additional follow-up will be carried out to establish data provider nodes in the institutions that participated in the Course. In addition China, unable to participate in the course, will be invited to establish data providers.

- The *Training Course on the Establishment of National Ocean Data Portal Nodes in the Black Sea region (ODINBlackSea) for Georgian and Turkish NODCs* was held from 21-23 December 2009 in Istanbul, Turkey. The aim of this course was to extend the number of data providers in the Black Sea region and to establish an ODP regional node.

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ANNEX X

PROPOSED FUTURE WORKPLAN, RESPONSIBILITIES, AND COSTING BASED ON PILOT PROJECT LEGACY RECOMMENDATIONS

		INSTRUMENT PRACTICES			
#	**Ref[1]**	**Action**	**By**	**Time frame**	**Cost**
1	2, 10	Update WMO and IOC Publications based on the proposed methodology (***Annex VII***) and seek harmonization of related standards between WMO and IOC. JCOMM observations Panels and associated programmes should help and provide resources.	Consultants, Task Teams	Ongoing (4-year cycle with priorities)	$5k/year
2	3	Follow up execution of Recommendation 3 (JCOMM-III) regarding the collection of instrument/platform metadata and their submission to the JCOMM ODAS Metadata Services (ODASMS, China), META-T servers (China, USA), and JCOMMOPS.	DMCG, OCG	Ongoing (biennial meetings of DMCG and OCG)	$10k/year
3	3	The JCOMM DMPA Task Team on Table Driven Codes needs to make proposals for updating the BUFR templates for VOS and buoy data for including instrument/platform metadata. These changes will be submitted to the IPET-DRC to permit validation, and future approval by the CBS.	TT TDC	2010	Self funded
4	3	NDBC needs to begin extracting metadata from surface drifter reports delivered in BUFR, and NMDIS needs to start extracting metadata from the available netCDF files at the Argo GDACs. USA and China should mirror their META-T servers, and make sure the metadata become discoverable through the ODP and/or WIS.	USA, China	2011	Self funded
5	2, 3	A proposal must be developed between JCOMM and CBS for including WMO Publication No. 47 regulatory part in the future WIS or WIGOS manual, and the ship metadata regarded as data as part of WIS. Publication No. 47 will eventually become obsolete.	JCOMM OCG, ICT-IOS	2010	See note[2]
6	4	JCOMM with the support from its ocean observations Panels and associated programmes, and in collaboration with the CIMO Management Group, needs to produce guidelines regarding marine instrument intercomparisons and	PP-WET, E-SURFMAR Consultant	2010	$10k (consultant)

1: This column makes reference to the legacy recommendation of the Pilot Project

2: No additional cost mentioned here, as the related cost is already covered elsewhere through other action(s)

		contribute to the CIMO Guide (WMO-No. 8, Chapter III.4). Particular assistance is required from the DBCP/ETWS Pilot Project on Wave Measurement Evaluation and Testing (PP-WET), and the E-SURFMAR.			
7	5	JCOMM OPA must follow up regarding establishment on Regional Marine Instrument Centres. This includes (i) learning from the US experience with its RMIC and the workshop that was organized at NDBC in early 2010; (ii) working with those countries (e.g. Morrocco, China) who also offered RMIC facilities; (iii) advertise availability of resources at existing RMICs with developing countries so that they can effectively use the facilities; and (iv) developing a scheme, and find resources, for regularly organizing events (training, intercomparisons) at RMICs.	Ad hoc meeting	End 2010	Self funded (e.g. VCP)
8	6	Follow up regarding IOC offering consultative status (or similar status) to HMEI. Continue working with HEMI so that more oceanographic equipment manufacturers become member of HMEI, and HMEI effectively contributes to marine instrument intercomparisons (e.g. manufacturers lending equipment), and to the standardization effort.	IOC	2011	N/A
		DATA EXCHANGE			
#		**Recommendation**	**By**	**Time frame**	**Cost**
9	7	Complete development of ODP version 2 (v2), and documentation, and demonstrate full compliance of the ODP with the WIS as a DCPC.	ETDMP Pilot Project	2 meetings in 2010, 2012	$40k
10	7, 8	Continue working with the agencies holding the identified datasets which connectivity with the WIS and/or ODP was proposed.	DMCG	Ongoing	See note[2]
11	7, 9	Continue working with the NODCs so that they develop interoperability with the ODP.	ETDMP, IODE	Ongoing	See note[2]
		QUALITY MANAGEMENT			
#		**Recommendation**	**By**	**Time frame**	**Cost**
12	10	Follow up Recommendation 4 (JCOMM-III) — Development of Data Management Standards. Standards should be proposed through the IODE/JCOMM standards process, and reviewed by ETDMP.	ETDMP Pilot Project on standards process	Ongoing	See note[2]
13	11	Follow up Recommendation 8 (JCOMM-III) — Implementation of Quality Management Systems for Met-Ocean Data, Products and Services by Members/Member States. In particular, Members implementing ocean observing networks and sharing data should be encouraged to document the processes, and WMO and IOC Publications reviewed and updated if necessary to achieve harmonization of standards being used.	DMCG	Ongoing	See note[2]
14	10	Follow up recommendations from the consultant who produced the JCOMM	OCG, DMCG	Ongoing	See note[2]

		Catalogue of Practices and Standards. The catalogue should be kept up to date. Also, the DMPA should review the GDAC documentation, and then add it to the JCOMM catalogue.			
		GOVERNANCE			
#		**Recommendation**	**By**	**Time frame**	**Cost**
15	13	OCG, and the Secretariats to seek additional resources for supporting JCOMMOPS	OCG, Secretariats	Ongoing	External resources
16	12	Promote establishing an international forum of users of satellite data telecommunication systems to address tariff negotiations, user requirements, and making recommendations on deficiencies and gaps related to the use of such systems.	WMO & IOC through OCG	By 2012	Self funded forum
17	15	A communication strategy should be promoted to address integration of marine meteorological and other appropriate oceanographic observations into WIGOS. Particular attention should be paid to (i) integration of *in situ* and satellite observations (use of *in situ* data for the calibration and validation of satellite products, merged *in situ*/satellite level 2 products as part of virtual constellations, bias correction, quality information feedback to observing platform operators), (ii) benefits & rationale for data exchange, (iii) benefits and rationale for collection and sharing of instrument/platform metadata.	DMCG, OCG	2012	See note[2]
		CAPACITY BUILDING			
#		**Recommendation**	**By**	**Time frame**	**Cost**
19	5	Organize training events at RMICs	OCG	1 workshop/year	$20k/year[3]
20	14	Organize PANGEA workshops	OCG	1 workshop/year	$20k/year[4]
21	7	Organize training events regarding WIS and/or ODP, and complete training materials	DMCG		See note[2]
22	2, 4, 7	Produce and submit appropriate information to the OceanTeacher.	OCG, DMCG		See note[2]

3: Funding from national and external sources (e.g. VCP) should be sought as much as possible, complemented by regular budget resources if available

4: Funding from national and external sources (e.g. VCP) should be sought as much as possible, complemented by extra-budgetary sources if available (e.g. DBCP)

ANNEX XI

LIST OF ACRONYMS

AAA	Authorization, Authentication and Accounting
AODCJF	Australian Ocean Data Centre Joint Facility
AODN	Australian Ocean Data Network
AOPC	Atmospheric Observation Panel for Climate
Argo	International profiling float programme (not an acronym)
ASAP	As soon as possible
ASAP	Automated Shipboard Aerological Programme
ASCII	American Standard Code for Information Interchange
BCOS	Bureau Composite Observing System (Australia)
BGODC	Bulgarian National Oceanographic Data Centre
BODC	British Oceanographic Data Centre (UK)
BOM	Bureau of Meteorology (Australia)
BPEL	Business Process Engineering Language
BUFR	Binary Universal Form for the Representation of meteorological data
CB	Capacity-Building
CBS	WMO Commission for Basic Systems
CDI	SeaDataNET Common Data Index
CEOS	Committee on Earth Observation Satellites
Cg	WMO Congress
CIMO	WMO Commission on Instruments and Methods of Observation
CONOPS	WIGOS Concept of Operations
CSV	Comma-Separated Values
DAR	Data Access and Retrieval
DBCP	Data Buoy Co-operation Panel
DBMS	Database Management System
DCD	Data Collection Platform
DCPC	Data Collection or Production Centre (of WIS infrastructure)
DMAC	IOOS Data Management and Communications (USA)
DMCG	JCOMM Data Management Coordination Group
DMPA	JCOMM Data Management Programme Area
DOI	Digital Object Identifier
DP	Data Provider
DWD	Deutscher WetterDienst
E2E	End-to-End Data Management
E2EDM	End-to-End Data Management Pilot Project
EC WG WIGOS-WIS	Executive Council working Group on WIGOS and WIS
EC	Executive Council
EDMED	European Directory of Marine Environmental Data
EDMERP	European Directory of Marine Environmental Research Projects
EDMO	European Directory of Marine Organisations
E-SURFMAR	Surface Marine programme of the Network of European Meteorological Services, EUMETNET
ET-AWS	Expert Team on Requirements and Implementation of Automatic Weather Station (AWS) Platforms
ETDMP	JCOMM Expert Team on Data Management Practices
ET-EGOS	CBS Expert Team on the Evolution of the Global Observing System
ET-GDDP	CBS Expert Team on GISC and DCPC Demonstration Process
ETMC	JCOMM Expert Team on Marine Climatology
ETRP	WMO Education and Training Programme
ET-WISC	CBS Expert Team on WIS GISCS and DCPCs
ETWS	JCOMM Expert Team on Wind Waves and Storm Surges
EUMETNET	The Network of European Meteorological Services
FAQ	Frequently Asked Questions
FTP	File Transfer Protocol
GAW	Global Atmosphere Watch
GCC	Global Collecting Centre
GDAC	Global Data Assembly Centre
GEO	Group on Earth Observations

GeoNetWork	A catalog application to manage spatially referenced resources (http://geonetwork-opensource.org/)
GEOSS	Global Earth Observation System of Systems
GFCS	Global Framework for Climate Services
GHRSST	Group for High Resolution SST
GIS	Geographical Information System
GISC	Global Information System Centres (of WIS infrastructure)
GLOSS	JCOMM Global Sea-level Observing System
GMDSS	Global Maritime Distress and Safety System
GODAE	Global Ocean Data Assimilation Experiment
GOOS	ICSU-IOC-UNEP-WMO Global Ocean Observing System
GOS	WMO Global Observing System
GOSUD	Global Ocean Surface Underway Data Pilot Project
GTS	Global Telecommunication System
GTSPP	Global Temperature and Salinity Profile Programme
HMEI	Association of Hydro-Meteorological Equipment Industry
HTTP	HyperText Transfer Protocol
IBSS	Institute of Biology of the Southern Seas National Academy of Sciences of Ukraine
ICG-WIS	Inter-commission Coordination Group on the WMO Information System
ICOADS	International Comprehensive Ocean-Atmosphere Data Set
ICSU	International Council for Science
ICT IOS	CBS Implementation-Coordination Team on IOS
ICTT-QMF	Inter Commission Task Team on Quality Management Framework
IMOP	WMO Programme for Instruments and Methods of Observation
INSPIRE	Infrastructure for Spatial Information in Europe
IOC	Intergovernmental Oceanographic Commission of UNESCO
IOCCP	International Ocean Carbon Coordination Project of IOC
IODE	International Oceanographic Data and Information Exchange of IOC
IOOS	Integrated Ocean Observing System (USA)
IOS	Integrated Observing Systems
IP	Implementation Plan
IPET-DRC	CBS Inter Programme Expert Team on Data Representation and Codes
IPET-MI	CBS Inter Programme Expert Team on Metadata Implementation
ISDM	Integrated Science Data Management (Canada)
ISO	International Organization for Standardization
JCOMM	Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
JCOMM-III	Third Session of JCOMM, Marrakech, Morocco, 4-12 November 2009
JCOMMOPS	JCOMM *in situ* Observation Programme Support Centre
LDCs	Least Developed Countries
LDP	ODP light Data Provider
M&G	Manual and Guides
MAN	JCOMM Management Committee
MARIS	Maris Technologies, Ltd (UK)
MCP	Marine Community Profile
MCS	Marine Climatological Summary
MCSS	Marine Climatological Summaries Scheme
MERSEA	Marine Environment and Security for the European Area (of EU)
META-T	Water Temperature instrument/platform metadata Pilot Project
MHI	Marine Hydrophysical Institute National Academy of Sciences of Ukraine
MIM	MERSEA Information Management
MQCS	Minimum Quality Control Standards
NC	National Centre (of WIS infrastructure)
NCDC	National Climate Data Centre
NCOSM	SOA National Centre of Ocean Standards and Metrology (China)
NDBC	National Data Buoy Centre (of NOAA, USA)
NetCDF	Network Common Data Form
NIMRD	National Institute for Marine Research and Development (NODEC/NIMRD)
NMDIS	SOA National Marine Data and Information Service (China)
NMHS	National Meteorological and Hydrographic Service
NOAA	National Oceanic and Atmospheric Administration (USA)
NODC	IODE National Oceanographic Data Centre
NWP	Numerical Weather Prediction
OAI-PMH	Open Archives Initiative Protocol for Metadata Harvesting

OBIS	Ocean Bio-geographical Information System
OceanSITES	OCEAN Sustained Interdisciplinary Timeseries Environment observation System
OCG	JCOMM Observations Coordination Group
ODAS	Ocean Data Acquisition System
ODASMS	ODAS Metadata Service (operated by China)
ODIN	IOC Ocean Data and Information Network
ODINAFRICA	ODIN for Africa
ODINBlackSea	ODIN for the Black Sea
ODINCARSA	ODIN for the Caribbean and South America
ODINWESTPAC	Ocean Data and Information Network for the WESTPAC
ODP	IODE Ocean Data Portal
ODS	Ocean Data Standards process
OGC	Open Geospatial Consortium
OPA	JCOMM Observations Programme Area
OPAG	Open Programme Area Group
OPeNDAP	Open-source Project for a Network Data Access Protocol
OT	OceanTeacher
OTN	Ocean Tracking Network
PA	Programme Area (of JCOMM)
PANGEA	JCOMM Partnership for New GEOSS Applications
PDF	Portable Document Format
PIRATA	Pilot Research Moored Array in the Tropical Atlantic
PO	Project Office
PP-WET	DBCP/ETWS Pilot Project on Wave Measurement Evaluation and Test
PSMSL	Permanent Service for Mean Sea Level
QA	Quality Assurance
QC	Quality Control
QM	Quality Management
QMF	WMO Quality Management Framework
QMS	Quality Management System
RA	WMO Regional Association
RIHMI-WDC	All-Russian Research Institute of Hydrometeorological Information – World Data Center
RMIC	WMO-IOC Regional Marine Instrument Centre
RNODC	IODE Responsible National Oceanographic Data Centre
RNODC/DB	RNODC for Drifting Buoys
RRR	WMO Rolling Review of Requirements
SDN	SeaDataNet
SeaDataNet	Pan-European infrastructure for Ocean and Marine Data Management
SG-ODP	IODE Steering Group for the Ocean Data Portal project
SOA	Service-Oriented Architecture
SOA	State Oceanic Administration (China)
SOC	JCOMM Specialized Oceanography Centre
SOC/DB	SOC for Drifting Buoys
SOS	Sensor Observation Services
SOT	JCOMM Ship Observations Team
SQL	Structured Query Language
SST	Sea Surface Temperature
TAO	Tropical Atmosphere Ocean network of tropical moorings
TIP	Tropical Mooted Buoy Implementation Panel
ToR	Terms of Reference
TT-TDC	JCOMM DMPA Task Team on Table Driven Codes
UNEP	United Nations Environment Programme
UNESCO	United National Educational, Scientific and Cultural Organization
USA	United States of America
VCP	Voluntary Cooperation Programme
VGISC	Virtual GISC (Europe)
VOS	Voluntary Observing Ship
VOSClim	VOS Climate Project
W3C	World Wide Web Consortium
WCS	Web Coverage Service
WDC	ICSU World Data Centre
WDIP	WIGOS Test of Concept Development and Implementation Plan

WDIS	WIGOS Development and Implementation Strategy
WESTPAC	IOC Sub-Commission for the Western Pacific
WFS	Web Feature Service
WG	Working Group
WHOI	Woods Hole Oceanographic Institution
WIGOS	WMO Integrated Global Observing System
WIP	WIGOS Implementation Plan
WIS	WMO Information System
WMO	World Meteorological Organization
WMS	Web Map Service
WOA	World Ocean Atlas
XBT	Expendable Bathythermograph
XCTD	Expendable Conductivity/Temperature/Depth
XML	Extensible Markup Language