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| **WORLD METEOROLOGICAL ORGANIZATION**  **\_\_\_\_\_\_\_\_\_\_\_\_\_** | **INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)**  **\_\_\_\_\_\_\_\_\_\_\_\_\_** |

**JOINT WORLD METEOROLOGICAL ORGANIZATION (WMO) AND INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC) OF UNESCO ~~WMO-IOC~~ STRATEGY FOR**

**MARINE METEOROLOGICAL AND OCEANOGRAPHIC DATA MANAGEMENT (2018-2021)**

**~~Draft V-0.47~~**

~~2018~~2019

**JCOMM Technical Report No. 40, Revision ~~4~~5**

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| **WORLD METEOROLOGICAL ORGANIZATION**  **\_\_\_\_\_\_\_\_\_\_\_\_\_** |  | **INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO) \_\_\_\_\_\_\_\_\_\_\_** |

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**NOTES**

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**JOINT WORLD METEOROLOGICAL ORGANIZATION (WMO) AND INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC) OF UNESCO ~~WMO-IOC~~ STRATEGY FOR MARINE METEOROLOGICAL AND OCEANOGRAPHIC DATA MANAGEMENT**

**(2018-2021)**

**DRAFT V0.47**

1. **EXECUTIVE SUMMARY**

The Joint World Meteorological Organization (WMO) and Intergovernmental Oceanographic Commission (IOC) of UNESCO Strategy for Marine Meteorological and Oceanographic Data Management, hereinafter called Joint Strategy provides a Vision and mechanisms for the period 2018 – 2021 so that ~~JCOMM~~ WMO and IOC will be able to deliver ~~its~~their mission, aligned with the JCOMM Vision and WMO and IOC strategic plans, in the field of marine meteorological and oceanographic (oceanographic and marine meteorological) data management in order to facilitate the collection, sharing and distribution of oceanographic and marine meteorological data, and their use by WMO and IOC users.

The Joint Strategy defines the mission with six outcomes, and seventeen deliverables with guidance on activities that can be conducted within ~~JCOMM~~ the mandate of the Joint WMO-IOC Collaborative Board but also in collaboration with other relevant WMO and IOC Constituent Bodies such as the IOC Committee on International Oceanographic Data and Information Exchange (IODE).

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

1. **METEOROLOGICAL AND OCEANOGRAPHIC DATA AND INFORMATION EXCHANGE IN THE WMO AND IOC FRAMEWORK**

The purpose of the Joint WMO-IOC ~~Technical Commission for Oceanography and Marine Meteorology (JCOMM)~~ Marine Meteorological and Oceanographic Data Management Strategy, hereinafter called Joint Strategy, is to address the Vision and objectives (see item 3. below) of ~~JCOMM~~ both Organizations with regard to marine meteorological and oceanographic (oceanographic and marine meteorological) data and information exchange in the WMO and IOC strategic framework. The ~~JCOMM Data Management~~ Joint Strategy is therefore responding to the current 2016-2019 and future 2020-2023 WMO Strategic Plans, and the IOC Medium Term Strategy 2014-2021. It is also consistent with the IOC Strategic Plan for Data and Information Management (2017-2021).

The ~~JCOMM Data Management~~ Joint Strategy will be implemented by WMO Members and IOC Member States under the ~~JCOMM Data Management Programme Area (DMPA)~~ umbrella of the Joint WMO-IOC Collaborative Board and in collaboration with the IOC Committee on International Oceanographic Data and Information Exchange (IODE), the ~~JCOMM~~ Observations Coordination Group (OCG) ~~Programme Area (OPA)~~ and other relevant WMO technical commissions and Research Board as needed. It will particularly address the needs of the IOC-WMO-UNEP-ICSU Global Ocean Observing System (GOOS), the WMO-IOC-UNEP-ICSU Global Climate Observing System (GCOS), the WMO Integrated Global Observing System (WIGOS), and the WMO Marine Meteorology and Oceanography Programme (MMOP) for oceanographic and marine meteorological data.

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1. **VISION**

3.1 VISION

Assuring the collection, processing, integration, dissemination and archiving of as much fit-for-purpose relevant data of known quality, to deliver to current demands for integrated oceanographic and marine meteorological information to the research and operational communities.

3.2 MISSION

To realize the Vision, ~~JCOMM~~ WMO and IOC will build on existing infrastructure, best practices and standards, and leverage from expertise of both ~~WMO and IOC~~ organizations. It will enable community efforts in data management in line with WMO Information System strategy (WIS 2.0), while seeking enhanced collaboration and partnerships from the public and private sector. It will promote cost effective modernization of current procedures and the use of new technologies and emerging data mechanisms where appropriate and applicable, as well as update existing practices and standards and develop new ones.

The goal is to make existing and new oceanographic and marine meteorological data available to the end users in such a way that they better meet the end user requirements and remain compliant with WMO[[2]](#footnote-2) and IOC[[3]](#footnote-3) data policies for free and unrestricted data exchange. Leverage will be from existing resources to minimize additional weight on data providers.

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1. **FRAMEWORK**

The ~~JCOMM data management~~ Joint strategy will help assure the collection, processing, integration, dissemination in real, near real time and delayed mode and the archiving of as much as possible fit for purpose oceanographic and marine meteorological data of known quality from various sources (Annex III) to meet the needs of WMO and IOC operational and research applications with the view to allow both Organizations to fulfil their mandates.

In particular, oceanographic and marine meteorological data collected and made available will allow substantial contribution to the protection of life and property against natural disasters, safeguarding of the environment and enhancement of the economic and social well-being of all sectors of society in areas such as food security, water resources and transport.

Targeted applications include ocean mesoscale forecasting, marine services, ocean and climate research, climate monitoring and services, sub-seasonal to longer range prediction, and numerical weather prediction, protection and sustainable development of the ocean and marine environment, and the effective management of marine resources. Developments in coupled forecast systems and Earth system modelling mean that the demands for integrated data delivery systems of oceanographic and marine meteorological (and other environmental data) are stronger than ever. These applications require oceanographic and marine meteorological observations of known quality to be available in real, near real time and delayed mode. Agreed standards and data management procedures are key for assuring the best use of oceanographic and marine meteorological data in such applications.

Guided by the Joint WMO-IOC Collaborative Board, the ~~The~~ implementation of the ~~Vision~~ Joint Strategy will be realized in the WMO and IOC Constituent Bodies framework, and ~~JCOMM~~ Infrastructure Commission on WMO side, and the IODE on IOC side in particular, relying on existing programmes and infrastructure provided by WMO Members and IOC Member States.

In particular, in the WMO framework, the ~~Data Management~~ Joint Strategy will build on the WMO Integrated Global Observing System (WIGOS) and the WMO Information System (WIS). WIGOS will provide for relevant best practices, standards, technical regulations and guidance, in particular with regard to observational ocean data user requirements for WMO Applications[[4]](#footnote-4) and the management of observing platform metadata following WIGOS Metadata Standard and requirement for recording such metadata in the OSCAR database. WIS will provide infrastructure, standards, technical regulations and guidance for the discovery and exchange of relevant data in real time and delayed mode to serve the needs of WMO users and beyond.

In the IOC framework, the Data and information management provides the mechanism for seamless interoperability of the dispersed oceanographic data management activities, including the real-time and delayed mode oceanographic data and services across all IOC and related programmes, handling data from the point of collection, through processing and quality control, to archival and dissemination. The European Union DG MARE long-term program, running from 2009, to develop the European Marine Observation and Data Network (EMODnet) provides easy access to marine data via seven thematic portals. For relevant EMODnet portals, close collaboration is made with the pan-European infrastructure for Ocean and marine data management (SeaDataNet) supported by the European network of National Oceanographic Data Centres (NODCs). The IOC Strategic Plan for Data and Information Management (2017-2021) includes a number of elements expected to facilitate the exchange and dissemination of data and services from these systems. For example, the IOC Data and Information System (ODIS) will provide seamless access to the real-time and delayed-mode oceanographic data and services across all IOC and related programmes, handling data from the point of collection, through processing and quality control, to archival and dissemination. The IODE developed Ocean Data Portal (ODP) will also be one of such elements. Data, metadata and information will be interoperable with the WMO Information System (WIS) and the ODP will function as a WIS Data Collection or Production Centre (DCPC) providing oceanographic data and services.

The Joint strategy recognizes and builds on the substantive community level data management activities undertaken by the oceanography and marine meteorology observing community (under the Observations Programme Area), and other data management entities (i.e. ICOADS, IQUOD, CMEMS, IOOS, SeaDataNet/SeaDataCloud, ODIP, IMOS, WOD, etc.,). Notably, the globally coordinated in situ observing networks take responsibility for the collection, management and delivery of observations, through web services and GTS in real time, and delayed mode QC, and archival through identified Global Data Assembly Centres (GDAC). GOOS Regional Alliances, are also pushing the boundaries of integrated data access and delivery through web services. It is hoped that many of the existing data systems (Argo GDACs, OceanSITES GDACs, etc.,) will become part of the MCDS (as DACs, GDACs and CMOCs). The JCOMM Observations Programme Area recognizes the need for integrating across network based GDACs, and sees the ERDDAP data platform as the vehicle to achieve this. ERDDAP in turn will enhance the capability of MCDS portals by providing interoperable access services to data.

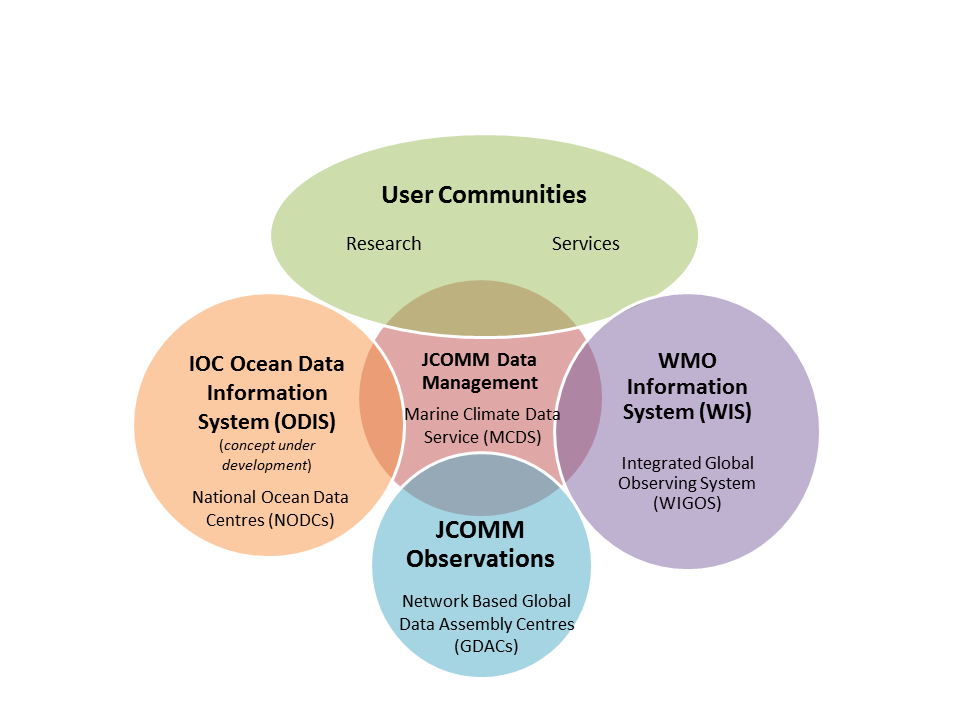


Figure 1. The ~~JCOMM~~ Joint Data Management strategy connects the Data Management frameworks of WMO and IOC/IODE such as WIS and IOC Ocean Data Information System (ODIS) (under development), drawing on the substantive data management activities through the ~~JCOMM~~ Observations Programme Area, to deliver to the broad range of users for oceanographic and marine meteorological data.

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1. **OUTCOMES EXPECTED FROM THE JOINT STRATEGY**

Consistent with the objectives of the ~~JCOMM~~ Joint Data Management Strategy, the following Outcomes are proposed:

|  |  |  |
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| ***Outcome*** | ***Theme*** | ***Goals and Objectives*** |
| 1 | Promoting data sharing | Promoting oceanographic and marine meteorological data sharing with the research and operational communities and the private sector in compliance with WMO Resolution 40[[5]](#footnote-5) (Cg-12), WMO Resolution 60[[6]](#footnote-6) (Cg-17), and the IOC Oceanographic Data Exchange Policy. |
| 2 | Data collection | Achieving more comprehensive, consistent and standardized collection of oceanographic and marine meteorological data from observing platforms in real time and near real time as needed. |
| 3 | Data integration, access, rescue and preservation | Integration of oceanographic and marine meteorological data, their quality control and value adding, including structured and regulated data flow, data rescue, archival/preservation and enhanced data access for end users via WMO and IOC information systems. |
| 4 | Data Dissemination | Achieving more comprehensive, consistent and standardized distribution of oceanographic and marine meteorological data to end users in real time and near real time as needed. |
| 5 | Data discovery | Making oceanographic and marine meteorological data sets discoverable using WMO and IOC information systems. |
| 6 | Capacity Development | Enhanced capacities of Members/Member States with regard to oceanographic and marine meteorological data management. |

**Outcome 1 - Promoting oceanographic and marine meteorological data sharing with the research and operational communities and the private sector in compliance with WMO Resolution 40[[7]](#footnote-7) (Cg-12), WMO Resolution 60[[8]](#footnote-8) (Cg-17), and the IOC Oceanographic Data Exchange Policy.**

To achieve this Outcome the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will develop rationale and plan to promote the sharing of oceanographic and marine meteorological data from organizations, institutions and private sector companies which are producing useful oceanographic and marine meteorological data but are not currently sharing their data (and metadata) with WMO and IOC ~~JCOMM~~ community. Efforts will also be made under this Outcome to enhance collaboration with the private sector in the area of data management, with the view to make the best use of the private sector capabilities with a win-win perspective.

The following activities will be carried out to accomplish this goal:

**Activity 1 – Plan for the promotion of data sharing and exchange**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will be promoting sharing and exchange of oceanographic and marine meteorological data with organizations and partners who are not currently sharing their data with WMO and IOC. The goal is to increase availability of fit for purpose oceanographic and marine meteorological data.

For example, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will develop rationale for convincing oceanographic and marine meteorological data producers to share data, define mechanisms for identifying existing sources of oceanographic and marine meteorological data for which the data are currently not being shared with WMO and IOC ~~JCOMM~~ users, and define mechanism(s) to be used to reach out with potential new sources of oceanographic and marine meteorological data.

The Observation Coordination Group (OCG) will lead this activity with close collaboration from panels/networks and JCOMMOPS. Efforts in this regard will be made in accordance with the Guidance on WIGOS Data Partnerships.

**Activity 2 – Plan for enhancing collaboration with the private sector**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will develop a plan for enhancing WMO and IOC collaboration with the private sector in the area of data management with the view to making the best use of the private sector capabilities with a win-win perspective. For example, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will identify private sector actors with whom collaboration could be strengthened or developed with regard to the management of oceanographic and marine meteorological data. It could also develop SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis with regard to enhanced collaboration with the private sector with regard to the management of oceanographic and marine meteorological data. Another activity would be to develop strategy and recommendations to ~~JCOMM,~~ WMO and IOC on how to enhance collaboration with the private sector with regard to the management of oceanographic and marine meteorological data.

This activity will be led by OCG and panels/networks with assistance from JCOMMOPS. Efforts in this regard will also be made in accordance with the Guidance on WIGOS Data Partnerships.

**Outcome 2 - Achieving more comprehensive, consistent and standardized collection of oceanographic and marine meteorological data from observing platforms in real time and near real time as needed.**

The goal under this Outcome is to facilitate collection of oceanographic and marine meteorological data in real time and delayed mode by refining the best practices and standards that are used in the WMO and IOC communities. This will apply to a variety of observing station types for which data are collected through different data telemetry systems, and data acquisition and processing systems, while applying some automatic (applied in real-time) and manual or semi-manual (applied in near real-time or delayed mode) quality control procedures.

The following activities will be carried out to accomplish this goal:

**Activity 1 - Rationalization and standardization of data collection**

The goal of the deliverable is to achieve more comprehensive, consistent and standardized collection of oceanographic and marine meteorological data from observing platforms in real time and near real time as needed. Satellite data collection will be achieved through working with observing platform operators, satellite data telecommunication service providers, and collect information on the performance and cost-effectiveness of such systems. Relay the collected information to the International Forum of Users of Satellite Data Telecommunication Systems (Satcom Forum).

Data collection formats will be standardized utilizing the existing knowledge and experience of observing platform operators, and seek to improve and rationalize the use of data collection formats. The primary objective is to recommend use of the existing community-proven standards while new standards may be proposed as needed in the process. The goal will be to achieve a smaller number of formats, and facilitate the processing of the collected data and their conversion to geo-physical units. Existing standards will be adopted and new standards developed for new sensor systems in order to facilitate the collection of sensor data by data acquisition systems into observations.

OCG will lead and JCOMMOPS will assist in completing this activity.

**Activity 2 - Uniformization and standardization of quality control procedures**

The oceanographic and marine meteorological data collected through telemetry systems require data processing and quality control in order to filter and/or tag data that are suspected or believed erroneous. The objective of this deliverable is to review existing quality control procedures and promote better uniformization and standardization of such procedures.

the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will collect information on existing quality control procedures and compile a document summarizing and referencing them. Based on the assessment of existing quality control procedures used for the collection of oceanographic and marine meteorological data, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will propose some uniformization and standardization of such procedures and take steps to integrate the automated QC procedure, wherever possible, to provide a uniform QC across networks. QC on real-time data will be led by panels/networks with OCG involvement. Delayed mode QC will be completed by the WMO Infrastructure Commission ~~Expert Team on marine Climatology (ETMC)~~, in consultation and collaboration with the WIGOS Data Quality Management System (WDQMS).

**Outcome 3 - Integration of oceanographic and marine meteorological data, their quality control and value adding, including structured and regulated data flow, data rescue, archival/preservation and enhanced data access for end users via WMO and IOC information systems**

To achieve this outcome the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will work to better integrate the management of oceanographic and marine meteorological data and will provide Members/Member States with clear guidance on how to use existing data systems or contribute to them. This will include the use of modern technology such as ERDDAP[[9]](#footnote-9) to provide an integrated data platform which can support many existing data systems. Effective scientific stewardship will be promoted with documented quality assurance and quality control procedures, together with the mechanism for users to report back on data quality problems. It will also include the further development, in collaboration with the IODE, of the Marine Climate Data System (MCDS) and its network of centres, including regulated flow of data, higher level quality control, data rescue, integration[[10]](#footnote-10) of oceanographic and marine meteorological observations, by variable[[11]](#footnote-11)-based products relying on value added and bias correction activities in particular, and preservation of the data in international archiving centres. Finally, under this Outcome, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will also strive to improve accessibility of oceanographic and marine meteorological data by the oceanographic (mainly research) community, in particular concerning the data that are distributed on the Global Telecommunication System (GTS) of WMO.

The following activities will be carried out to accomplish this goal:

**Activity 1 – Guidance to Members and Member States on how to use existing oceanographic and marine meteorological and other relevant data systems, including description of governance and processes**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will develop guidance material to WMO and IOC Members and Member States with the goal to assist them using existing oceanographic and marine meteorological and other relevant data systems, and show them how to contribute their relevant capabilities to WMO and IOC. Outreach and training material shall also be developed to assist Members/Member States to undertake fit for purpose data management for oceanographic and marine meteorological data.

A large diversity of data management systems and capabilities exist in the oceanographic and marine meteorological community. It is therefore important to have a review of such systems and capabilities, and to provide guidance to Members and Member States on how to make the best use of them in order to maximize the use of fit for purpose oceanographic and marine meteorological data. Existing data systems are also governed differently whether they lie with WMO or IOC, and different processes may apply for establishing new centres or maintaining or creating new standards and best practices, whether through IODE of IOC, the Joint WMO-IOC Collaborative Board ~~JCOMM~~, other Constituent Bodies of WMO and IOC, or partner organizations. The ~~JCOMM~~ Joint Data Management Strategy is therefore promoting the development of appropriate guidance to Members and Member States.Training and outreach material will be developed on the management of oceanographic and marine meteorological data. ~~Data Management Coordination Group (DMCG)~~ The WMO Infrastructure Commission will take the lead with assistance from OCG and IODE in completing this activity.

**Activity 2 – Marine Climate Data System (MCDS) / Development of the CMOC Network in collaboration with IODE**

Under this deliverable, building on existing infrastructure, the Joint WMO-IOC Collaborative Board ~~JCOMM~~, in collaboration with the IODE, will further develop and coordinate the network of Centres for Marine Meteorological and Oceanographic Climate data (CMOCs) in the Marine Climate Data System (MCDS) framework. JCOMM-5 ~~will have~~ has introduced new Technical Regulations for the MCDS to replace the former Marine Climatological Summaries Scheme (MCSS). MCDS constitutes a modernization of the MCSS and regulates the flow of marine climate data from various data sources to CMOCs. In the process, oceanographic and marine meteorological data are integrated by variable-based products following value adding processes, including bias correction. CMOCs are making such products available to end users while mirroring their data sets with each other. CMOCs will further develop and enhance data processing, quality control, value adding, and variety of delivered products of existing CMOC(s).

At this stage, two CMOCs have been established at the SOA National Marine Data and Information Service (NMDIS) in Tianjin, China (CMOC/China) and NOAA’s National Centers for Environmental Information (NCEI) World Ocean Database (WOD), in Silver Spring, Maryland, USA. JCOMM has been working with CMOC/China to refine the work plan for the centre and in reviewing their annual reports. CMOC-WOD is new and is just getting established in the current MCDS structure. Efforts will have to be made to monitor the work plans and make sure they are progressing. the Joint WMO-IOC Collaborative Board ~~JCOMM~~ shall also working to establish additional CMOCs in other regions or data management areas, including potential candidates such as the International Comprehensive Ocean-Atmosphere Data Set (ICOADS).

The WMO Infrastructure Commission is~~DMCG and ETMC are~~ primarily responsible for this activity with the assistance form IODE.

**Activity 3 – Marine Climate Data System (MCDS) / Development of the DAC and GDAC Network in collaboration with IODE**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~, in collaboration with the IODE, will further develop the network of Data Acquisition Centres (DACs) and Global Data Assembly Centres (GDACs). While the CMOCs provide the high level functions of the MCDS and make end user products available to end users, it is critical to make sure that the flow of marine meteorological and other appropriate oceanographic data is assured from the diversity of data sources, whether real-time or delayed mode, to the CMOCs. This data flow is assured through a network of Data Acquisition Centres (DACs) and Global Data Assembly Centres (GDACs) according to the Terms of Reference of such centres as regulated within the MCDS.

While a small number of DACs and GDACs ~~will~~ have been established by JCOMM-5 (e.g. Canada for the Drifting Buoys), the Joint WMO-IOC Collaborative Board ~~JCOMM~~ shall make efforts to establish new centres in the view to cover a wider spectrum of oceanographic and marine meteorological observing platform types. In order to complete the network of GDACs, in particular with regard to the collection of oceanographic data, efforts shall also be made to converge the Terms of Reference of the MCDS GDACs with those of the IODE GDACs, so that they will eventually become joint MCDS-IODE GDACs. Strong collaboration and synergies with IODE shall be promoted.  ~~DMCG together with ETMC~~ the WMO Infrastructure Commission with the assistance from IODE and OCG will lead this activity.

**Activity 4 – Accessibility of oceanographic and marine meteorological data by the ocean community to GTS data in near real-time**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will develop a pilot project, which aims to facilitate access by users outside of National Meteorological and Hydrological Services (NMHS) to oceanographic and marine meteorological data distributed in real-time through the Global Telecommunication System (GTS) of WMO.Development and implementation of the JCOMM Open GTS Pilot Project, which will allow users outside of NMHS to access oceanographic and marine meteorological data that are being distributed in real-time through the Global Telecommunication System (GTS) of WMO. OCG will take the lead on this activity with the support from members and members states and WMO/WIGOS.

**Activity 5 – Integration of oceanographic and marine meteorological observations by variable-based products, including value-added and bias correction**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will work towards better integration of oceanographic and marine meteorological observations by variable-based products, including value-added and bias correction. The development of the MCDS requires using state of the art integrated and standardized international systems for the improved data and metadata flow and management of a wide range of oceanographic and marine meteorological climate data. This includes integrating collection, rescue, quality control, formatting, archiving, exchange, and access of in situ and satellite sources. MCDS is based on improved quality management, documenting processes and procedures, using higher level quality control, added value data processing, including bias correction, and comparison of the observations with satellite and meteorological and oceanographic model gridded fields. It is expected that the relevant data and associated metadata will be of known quality, and extend to products that satisfy the oceanographic and marine meteorological climate data requirements for climate monitoring, forecasting, and services.

the Joint WMO-IOC Collaborative Board ~~JCOMM~~ shall make efforts to further develop the MCDS in the view to enhance quality control and value adding procedures, and increase the number of variable-based and specialized collections (e.g. extreme events, El Niño events) and end user oceanographic and marine meteorological products.

the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will develop and implement Versioning schemes to trace workflow from “raw” or “real-time” data through QA/QC and other procedures that lead to subsequent versions (e.g. “Delayed-mode.”). Unique Identifiers will be used to allow identification of duplicates and/or related datasets and products, and procedures proposed for eliminating exact and inexact duplicates, as well as facilitating search/browse for related data sets and products. Efforts will be made to collect and maintain metadata for all datasets to capture provenance and the used procedures. In doing so, users will be able to trace workflow from sensor to the product they are using (i.e. processing history is retained), as well as evaluating fitness for purpose and identifying “best” version of the data for their needs.

For the Metadata completeness, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will engage with data producers and make sure to satisfactorily capture, communicate and expose metadata attribution. Efforts will be made to come up with and adopt an effective metadata categorization scheme at different levels, i.e. (i) collection/discovery[[12]](#footnote-12), (ii) provenance/lineage[[13]](#footnote-13), (iii) and platform/instrument[[14]](#footnote-14). Compliance with WIGOS Metadata Standard will be sought for sensor/instrument/platform metadata. This activity will be implemented by ~~ETMC and DMPA~~ the WMO Infrastructure Commission with assistance from OCG and JCOMMOPS.

**Activity 6 - Scientific Stewardship**

Effective scientific stewardship will be promoted with documented Quality Assurance (QA) and Quality Control(QC) procedures together with mechanism for users to report back on data quality problems. The purpose of this activity is to promote data centres to document their QA and QC procedures, and provide them with guidance in this regard. the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will then maintain a catalogue of those centres documenting their procedures and making it publicly available.

Efforts will be made to assure that users of oceanographic and marine meteorological data will have the opportunity to provide feedback to data centres and data producers on the quality of the data. Some processes and procedures will be defined and recommended, aligned in particular with the requirements of the WMO Integrated Global Observing System (WIGOS) Data Quality Monitoring System (WDQMS). Global Ocean Observing System (GOOS) will lead this activity in consultation and collaboration form WDQMS.

**Activity 7 – Data Rescue**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will promote the rescue of oceanographic and marine meteorological data with the view to integrate them into CMOCs data sets. Collaboration with the IODE Global Oceanographic Data Archaeology and Rescue (GODAR) project and other similar projects such as C3S Data Rescue Service Project(C3S-DR) under Copernicus, Atmospheric Circulation Reconstructions over the Earth (ACRE), will develop guidance material to be made available or developed on oceanographic and marine meteorological data rescue. Developing and promoting Crowdsourcing activities for oceanographic and marine meteorological data rescue will also be pursued.  ~~DMCG and ETMC~~ The WMO Infrastructure Commission will take the lead on this with the assistance from IODE and Global Oceanographic Data Archaeology and Rescue (GODAR). Collaboration with other initiatives such as EMODNET will also be sought.

**Activity 8 – Integrated access to oceanographic and marine meteorological data and products using modern technology**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will develop and promote mechanisms for integrated access to oceanographic and marine meteorological data and products using modern technology. The goal is to dramatically decrease the user effort required to access data from multiple networks in multiple formats and eliminate the need to transform various data formats to make them suitable for analysis tools. Additionally, while it is important to provide improved access to data and metadata, an effort should be made to accomplish that goal without overwhelming data providers with additional requirements. Such burdens can be minimized by leveraging existing tools and services that have a proven track record in the oceanographic and marine meteorological community.

the Joint WMO-IOC Collaborative Board ~~JCOMM~~ shall be working towards developing an overarching framework to integrate both real-time and delayed mode oceanographic and marine meteorological data networks. It is proposed to use ERDDAP as the foundation of the framework, as this platform provides accessibility, metadata harvesting, connection to legacy formats, web services and machine to machine data access. ERDDAP can also assist data providers in building data packages suitable for archive. Users can utilize its powerful RESTful API to access and discover the data through a variety of interoperable services. For ocean data, such a request can produce a custom data subset, pre-formatted to the needs of an application (e.g. KML format for Google Earth) as well as metadata, images, and analyse results. This activity will be led by OCG.

**Outcome 4 - Achieving more comprehensive, consistent and standardized distribution of oceanographic and marine meteorological data to end users in real-time and near real-time as needed**

Dissemination of oceanographic and marine meteorological data in real and near real time to WMO and IOC end users is key. To achieve this outcome the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will take steps to modernize existing data management practices in this area, and develop new practices and standards as needed with the view to facilitate exchange and distribution of oceanographic and marine meteorological data in a timely manner in order to meet the latency requirements of operational applications (e.g. numerical weather prediction, ocean mesoscale forecasting, wave modelling, Tsunami monitoring). This will include working on Table Driven Codes, including reviewing, updating, and creating BUFR[[15]](#footnote-15) and NetCDF[[16]](#footnote-16) templates for oceanographic and marine meteorological data of various types. Data will also be made available in a timely manner through servers in appropriate and agreed formats.

The following activities will be carried out to accomplish this goal:

**Activity 1 – Modernized and new data management practices and standards**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will be working at modernizing existing data management practices for oceanographic and marine meteorological data, and develop new practices and standards as needed with the view to facilitate data exchange, data processing and archiving.

the Joint WMO-IOC Collaborative Board ~~JCOMM~~ willreview and assess existing data management practices in the WMO and IOC communities as well as in national or international frameworks (i.e. IMOS/AODN, SeaDataNet, IOOS) with regard to oceanographic and marine meteorological data. Identify elements of the existing data management practices (e.g. GEOSS data management principles[[17]](#footnote-17)) and associated vocabularies that can be adopted or easily modernized to meet requirements.

the Joint WMO-IOC Collaborative Board ~~JCOMM~~ should propose modernization of some existing data management practices, contribute documents to the IODE Ocean Data Standards and Best Practices (ODSBP) repository, and plan for the promotion and use of new data management practices, technologies and emerging data mechanisms, including big data. See [Annex II](#2bn6wsx) for the the Joint WMO-IOC ~~JCOMM~~ perspective on big data, (Shared responsibility OPA, DMPA). Completion of this activity will be collaboratively led by relevant Expert Teams in the WMO Infrastructure Commission ~~DMCG,~~ IODE~~,~~ Expert Team on Data Management practices (ETDMP) ~~and JCOMM Inter Programme Expert Team for Integrated Marine Meteorological and Oceanographic Services within WMO and IOC Information Systems (IPET-MOIS)~~, also with the assistance from Ocean Data Standards and Best Practices (ODSBP) within IODE.

**Activity 2 – New and updated templates for Table Driven Codes**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will undertake maintenance and update templates used for the exchange of oceanographic and marine meteorological data in real-time using table driven codes.As migration to Table Driven Codes (TDCs) in WMO is nearing completion, it is critical to assure that the templates used for the exchange of time critical oceanographic and marine meteorological observations in real-time through the Global Telecommunication System (GTS) of the WMO Information System (WIS) are continuously reviewed and updated to make sure that new types of observations, high temporal and spatial resolution oceanographic and marine meteorological data can be encoded in TDCs and comply with the end user requirements. Coordinator on Table Driven Code and (TT-TDC) and the IPET-MOIS will lead this activity.

**Outcome 5 - Making oceanographic and marine meteorological data sets discoverable using WMO and IOC information systems**

To achieve this outcome the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will take steps for making oceanographic and marine meteorological data sets discoverable by WMO and IOC users using the WMO and IOC information systems, including the WMO Information System (WIS), and the IOC Ocean Data Information System (ODIS). Concerning ODIS, the IODE Ocean Data Portal (ODP) being part of ODIS, interoperability of the ODP with the WIS shall be further developed and completed. ODIS will also be linking various data systems used in the ocean community, so this Outcome will also have the objective of linking ~~JCOMM~~ relevant WMO and IOC data systems (MCDS, WIS, etc.,) with ODIS. Further, new technologies such as Big Data (BG) and Cloud Computing (CC) will be discussed and evaluated in a metadata discoverability prospective to adopt these new evolving technologies in ~~JCOMM~~ Joint DM.

The following activities will be carried out to accomplish this goal:

**Activity 1 – Interoperability of oceanographic and marine meteorological data sets and products with the WMO Information System (WIS)**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will develop integrated marine meteorological and oceanographic services within the WMO Information System (WIS). The goal is to build and activate the interfaces between Marine Meteorology and Oceanographic services and the WIS, and thereby facilitate oceanographic and marine meteorological metadata/data discovery, access and retrieval. See Annex I for details.

the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will work on development and endorsement of ~~JCOMM~~ Joint WMO-IOC led procedures for application, evaluation and endorsement of existing and new Marine centres as national centres (NC) or as Data Collection or Production Centres (DCPC) under WIS. It will also promote access and discovery of oceanographic and marine meteorological metadata and data sets within WIS. IPET-MOIS will lead this activity.

**Activity 2 – Interoperability of oceanographic and marine meteorological data sets and products with the Ocean Data Information System (ODIS) including ODP ( MCDS, WIS, ….)**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will collaborate with the IODE for the development of the IOC Ocean Data Information System (ODIS) taking into account the ~~JCOMM~~ Joint Data Management Strategy and WMO and IOC frameworks concerning data and information management. The goal will be to achieve interoperability of oceanographic and marine meteorological data systems and centres to ensure ODIS is inclusive and supports stakeholders at all levels.

In particular, the Joint WMO-IOC Collaborative Board ~~JCOMM~~, the WMO Infrastructure Commission and the IODE Expert Team on Data Management Practices (ETDMP) will support and assist the development of the ODIS concept paper considering fundamental issues ranging from infrastructure, standards, and strategies for harmonization.

the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will also collaborate with the IODE for the further development, evolution and promotion of the IODE Ocean Data Portal (ODP). The goal will be to increase interoperability of oceanographic and marine meteorological data systems and centres with the ODP and WIS so that oceanographic and marine meteorological data sets are discoverable through both ODP and WIS. Members and Member States will be encouraged to apply for their relevant infrastructure to become Data Production and Collection Centres (DCPCs) under the WIS.

IPET-MOIS together with IODE and ETDMP will lead this activity.

**Activity 3 - Evaluate new evolving technologies such as Big Data (BG) , Cloud Computing (CC) for metadata discoverability to adopt in Joint WMO-IOC Data Management~~JCOMM DM~~**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will investigate and evaluate how BG and CC can be adopted to the Joint WMO-IOC Data Management ~~JCOMM DM~~ in relation to the technology, data streams and workflow speeds, quality, networking of distributed data systems and services, interoperability, etc. This evaluation will be based on the 5 Vs: volume, veracity, variety, velocity and value. In particular, use of common standards (veracity, variety) on profiles for metadata, data and data products and interoperability solutions so that data and products can be easily shared and combined in a meaningful way; about high quality metadata (veracity) so as to have a meaningful result when we mix data together; about the need of provenance metadata when putting data together from different resources, or use different versions of data sets; about improved workflows from observations systems to the application and users (velocity); and about connecting Marine Meteorological and Oceanographic Centres with WMO and IOC Information Systems , MCDS, which are addressing all the above.

This activity will be led by ~~DMCG~~ the WMO Infrastructure Commission in liaison with OCG.

**Outcome 6 - Enhanced capacities of Members/Member States with regard to oceanographic and marine meteorological data management**

Under this Outcome, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will endeavour to strengthen ~~JCOMM~~ WMO and IOC capacity development activities and training in the field of management of oceanographic and marine meteorological data by making the best use of existing resources within WMO and IOC in this regard. This will also include collaboration with IODE and other partners. It is expected that such activities will help the developing and enhancing capacities of WMO Members and IOC Member States with regard to oceanographic and marine meteorological data management.

The following activity will be carried out to accomplish this goal:

**Activity 1 – Capacity development and training on oceanographic and marine meteorological data management**

Under this deliverable, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will endeavour to strengthen ~~JCOMM~~ WMO and IOC capacity development activities and training in the field of management of oceanographic and marine meteorological data in collaboration with IODE and other partners, and to contribute to the six outputs of the IOC Capacity Development Strategy (2015–2021) adopted by the IOC Assembly at its 28th Session.

In achieving this, the Joint WMO-IOC Collaborative Board ~~JCOMM~~ will work towards developing OceanTeacher content for all IOC programmes, exploit OTGA Regional Training Centres and WMO Training Centres for regional training programmes and encourage continuous professional development using the OceanTeacher platform. Further, deliver joint training courses with international agencies and programmes such as IODE, POGO, IOI, GOOS. Activity 1 under Outcome 3 is applicable to achieve this outcome.

This activity is a cross-cutting responsibility for all programme ~~areas~~ activities of the Joint WMO-IOC Collaborative Board ~~JCOMM~~. ~~Thus JCOMM Management team will lead the activity with close collaboration from all JCOMM panels.~~

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1. **IMPLEMENTING THE JOINT STRATEGY**

~~JCOMM Data Management Programme Area~~ The Joint WMO-IOC Collaborative Board will develop an implementation plan aligned with the ~~JCOMM~~ Joint Data Management Strategy. The Implementation Plan will distribute the work and use the ~~JCOMM DMPA working structure to distribute the work but also liaise and collaborate with the~~ WMO Technical Commission on Infrastructure ~~other JCOMM Observations (OPA) and Services and Forecasting Systems (SFSPA) Programme Areas~~, the IODE and other relevant Constituent Bodies of WMO and IOC, to develop the plan and have it executed.

The Implementation Plan shall be structured by deliverable, identifiable actions with clear deadlines and implementation actors and provide for Key Performance Indicators (KPIs) that are SMART, i.e. Specific, Measurable, Achievable, Relevant and Time phased.

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**ANNEX I**

**INTEGRATING MARINE METEOROLOGICAL AND OCEANOGRAPHIC SERVICES WITHIN WIS**

The **JCOMM Cross-cutting Task Team for Integrated Marine Meteorological and Oceanographic Services within WIS (TT-MOWIS)** ([http://www.jcomm.info/  
index.php?option=com\_oe&task=viewGroupRecord&groupID=318](http://www.jcomm.info/index.php?option=com_oe&task=viewGroupRecord&groupID=318)) was established by JCOMM to provide a mechanism for international coordination of oceanographic and marine meteorological observing, data management and services.

The work of this team represents a close collaboration with the WMO Information System (WIS), leveraging the success of the WIS operating model and resulting in greater harmonization of operational marine meteorological data and services. Although this effort is focused primarily on operational centres, the implementation of a WIS-like model under JCOMM requires a robust and highly available technical environment, technically and semantically interoperable data and information, both supported through personnel and processes.

To manage the disparities in capabilities of the contributing institutes/systems, and to implement redundancy/failover and high availability of data and information, the type of hierarchical data network structure employed by WIS is relevant to the Ocean Information System to be developed under MOWIS. These areas of focus are all relevant to the Ocean Data and Information System envisioned through the IOC audit, and there are opportunities for the global effort to draw upon the expertise from TT-MOWIS and related efforts.



Figure 1: WMO WIS, the Ocean Information System (OIS) and Interface via JCOMM

**ANNEX II**

**Joint WMO-IOC ~~JCOMM~~ PERSPECTIVE ON BIG DATA**

**1. Big Data Definition**

One of the major initial issues, of course, is to define what “big data” is, and this depends on what people are expecting to do with the data and, to a lesser extent, their capability to deal with varying amounts of data.

Today, Big Data is not only a volume or data storage issue, but more complex; it is related to many other things, such technology, data streams and workflow speeds, quality, networking of distributed data systems and services, interoperability, etc.

There are several definitions for Big Data, the more commons ones are related to the five V’s: Volume, Variety, Velocity, Veracity and Value.

**2. Characters of Big Data**

**2.1 Big Data Volume**

Since we cannot move data to the users, we move users to data and provide them with online processing tools to analyse the data. (Cloud sourcing/computing is the future working environment).

* In general, volume is not a major concern for present day in situ observing systems under ~~JCOMM~~ joint WMO-IOC purview (compared to over land) as there will remain the need for a platform (buoy, ship, autonomous vehicle), even if most of these are operated by third parties. One exception is remotely sensed streams from satellites, some very high frequency sampling from radars and specialized instrumentation. The potential for citizen science-based observations (e.g. scuba divers, recreational boating, etc.,) is important to consider, especially for coastal regions. Opportunities for expanding observations from commercial shipping or industry, such as oil and gas exploration, might also be anticipated but have been slow to develop. As ocean observing requirements for bio-geochemistry and biology become more mature, the volume of data (particularly from visual imagery and data from multi-spectral chemical and acoustic sensors) may increase many fold. This increased volume will become an ever-increasing challenge. Moreover, sampling frequency and pure numbers of platforms will increase, as will the number of autonomous platforms (which require more data for operations and status reporting). Lastly, value-added products from high resolution models, data assimilation systems, and forecast systems, will continue to tax current telecommunications and data infrastructures due to their extremely high volume.

* However, it bears noting that though data volume from observational (not model-based projects) may not be large, they represent a very significant portion of the scientific input, especially in terms of the oceans, and care is required to ensure that they are not lost in the big data shuffle.
  1. **Big Data Variety**

Variety has to do with the integration of different data types from different sources.

* This is a significant Big Data challenge (see above). Unlike the weather community, the ocean community has not as quickly moved to a single standard data format. While more mature ocean observing systems (e.g. Argo, TAO-TRITON) are using well-documented reporting standards (for real-time and delayed-mode data), several other observing systems and programmes have created methods and formats that serve only limited numbers of researchers and users. The use of standards is a critical step forward towards discovery, provision, and access to a wide variety of data.
* Movement toward standards for metadata and data, such as the CF conventions, and the OGC O&M conventions are bringing the variety of possible data formats and models down and increasing ease of access and use.
* In addition, use of interoperable web services are allowing data to be served to users in such a way that they need not be concerned about the underlying format of the data. This capability allows for a wide variety of data to be served to users through standard and well-defined API’s.

**2.3 Big Data Velocity**

Velocity is related to the speed when we move the data around.

The input and output data flow rates seem to be manageable in most cases in current OCG/OOPC activities. However, data latency is still an issue for some data streams in some parts of the world. Moreover, as volumes of information increase, there is a risk downstream users in developing countries (or those with inadequate communications infrastructure) will be even less able to access the wealth of information. Tools for quickly browsing/subsetting/hyperslicing on remote machines must be developed.

**2.4 Big Data Veracity**

Veracity has to do with the data quality and how data fit for purpose. We need, thus, good metadata when we combine different resources together, thereby reducing data uncertainty and creating trusted sources.

* More effort is required to establish and carry forward, with the data, its provenance, and systematic automated QC on NRT data would be helpful, as this would improve metadata for broader use. Moreover, documented post calibration, refined QC, and DOI assignment on delayed mode data would further strengthen the data.
* It will be important to ensure that ‘big data’ doesn’t simply lead to a huge volume of very poor quality (or unusable) data which has little real value. All observational data should have attributes describing quality (even if quality is relatively poor).
* The approach being advocated by some partners for third party marine data is that, for data from professional organizations (research institutes, governmental bodies, industry etc.,), we are happy to accept data in standard (non-WMO) formats (e.g. netCDF, XML etc.,) and ensure they are subjected to automated real-time QC before being made available to our modelling systems (or distributed on GTS in WMO formats where appropriate).

**2.5 Big Data Value**

Making the data valuable to the users.

* The data collections serve many people well. However more can be done to integrate collections along EOV lines rather than platform types or collection schemes, and to break down the barriers that currently form between the different observing systems.
* Do not lose sight of the relevance of having expert consults and data stewards attached to the data service and development.
* Providing interoperable access services to data is crucial for realizing the value inherent in such data.

* Providing standard-compliant metadata also increases the value of data by ensuring that the data is findable, re-usable and understandable, both by machines and humans.

**3. Joint WMO-IOC ~~JCOMM~~ Considerations of Big Data**

~~In JCOMM~~ We address the above issues and the already changed strategy/priorities are facing the Big Data challenges.

* We speak about use of common standards (veracity, variety) on profiles for metadata, data and data products and interoperability solutions so that these data and products can be easily shared and combined in a meaningful way.

* We speak about high quality metadata (veracity) so as to have a meaningful result when we mix data together.
* We speak about the need of provenance metadata when putting data together from different resources, or use different versions of data sets.
* We speak about improved workflows from observations systems to the application and users (velocity).
* We speak about connecting Marine Meteorological and Oceanographic Centres with WMO and IOC Information Systems , MCDS which are addressing all the above.

Within the 1st ODIP II Workshop ([www.odip.org](http://www.odip.org/)), there was a Session on Model workflows and Big Data (Session 7: <http://www.iode.org/index.php?option=com_oe&task=viewEventAgenda&eventID=1737>).

ODIP is a H2020 EU project, working together with experts from USA and Australia for a common framework on marine and ocean data management.

Users, organizations (Met. Services, NODCs), society, etc., can only benefit if we address the above successfully. Modern technologies and open sources tools and applications are offering the solutions to access and process efficiently the large amounts of interdisciplinary data. Of course, the above require open data access, otherwise users registration and access control is needed.

The success is in working with interested parties such as the private sector to turn this “big data” into the information which the end users require, through such things as Apps, APIs and digitization. Cost may be reduced for observations, data management and processing, modelling and forecasting services on condition that proper data sharing and exchange and quality control/management mechanisms are in place.

**4. Challenges to WMO and NMHSs**

* The WMO community needs to understand how it can best work with the private sector to optimise use of big data for the benefit of all.
* Private sector has more flexibility, even more resources (e.g. Amazon/Google/IBM etc.), if engaged in observations, data management and better efficiency in services provision, such as smart phone Weather Apps widely used - although quality may be variable at times.
* When quality is managed and controlled, the private sector will be able to set best practices and standards, which conventionally relies much on public sector and international/intergovernmental organizations.
* Need to revisit private-public partnership and develop an understanding of how issues of big data and associated standards may affect, for example, the boundary of the authoritative voice for weather, climate and water.

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**ANNEX III**

**EXISTING SOURCES OF OCEANOGRAPHIC AND MARINE METEOROLOGICAL DATA**

| *Data type* | *DATA SOURCE* | | |
| --- | --- | --- | --- |
| *Real-time* | | *Delayed mode* |
| Upper Ocean T&S | GTS | | Global Temperature and Salinity Profile Programme (GTSPP)  <http://www.nodc.noaa.gov/GTSPP/> |
| Surface underway T&S | GTS | | Global Ocean Surface Underway Data (GOSUD)  <http://www.gosud.org/> |
| Underway surface ocean and marine MET data[[18]](#footnote-18) (SAMOS) | DACs | | Shipboard Automated Meteorological and Oceanographic System (SAMOS)  <http://samos.coaps.fsu.edu/html/> |
| Argo profiling float data | GTS and GDACs | | Argo Data System – <http://www.argo.ucsd.edu/Argo_data_and.html>  The Argo Data System is comprised of:   * Argo Global Data Assembly Centres (GDACs) * Argo national Data Assembly Centres (DACs)) * Argo Regional Centres (ARCs) |
| Drifters | GTS | | MCDS trail GDAC for drifting buoys – <http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/drib-bder/index-eng.htm>  Global Drifter Programme (GDP) Drifter Data Assembly Centre (DAC) – <http://www.aoml.noaa.gov/phod/dac/dacdata.php> |
| Meteorological Moored Buoys | GTS | | National Meteorological and Hydrological Services (NMHSs) operating the buoys, e.g.  USA: <http://www.ndbc.noaa.gov/> |
| Tropical moored buoys | GTS | Global Tropical Moored Buoy Array (GTMBA)  TAO (Tropical Pacific Ocean): <http://www.pmel.noaa.gov/tao/>  TRITON (Western Tropical Pacific Ocean): <http://www.jamstec.go.jp/jamstec/TRITON/real_time/>  PIRATA (Tropical Atlantic Ocean): <http://www.pmel.noaa.gov/pirata/>  RAMA (Tropical Indian Ocean): <http://www.pmel.noaa.gov/tao/rama/> | |
| Tsunameters | GTS | International Tsunami Information Centre (ITIC):  <http://itic.ioc-unesco.org/index.php> | |
| Ocean Reference Sites | GTS | OceanSITEs: Deep Ocean Time-Series Multidisciplinary data  <http://www.oceansites.org/>  OceanSItes GDACs at IFREMER (France) and NOAA/NDBC (USA):  <ftp://ftp.ifremer.fr/ifremer/oceansites/>  <ftp://data.ndbc.noaa.gov/data/oceansites> | |
| VOS | GTS | Marine Climatological Summaries Scheme (MCSS) Global Collecting Centres  (UK: <http://www.metoffice.gov.uk/public/weather/marine-observations/#?tab=marineObsMap>, and  Germany: <http://www.dwd.de/DE/leistungen/gcc/gcc.html>)  (IMMT format)  International Comprehensive Ocean-Atmosphere Data Set (ICOADS) – <http://icoads.noaa.gov/> | |
| Tide gauges | GTS | Global Sea Level Observing System (GLOSS)  <http://www.gloss-sealevel.org/data/> | |
| Gliders | Distribution via GTS under consideration | Miscellaneous  <http://www.ego-network.org/dokuwiki/doku.php> | |
| High Resolution SST data from satellites | GTS and DACs | Group for High Resolution Sea Surface Temperature (GHRSST) Regional Data Assembly Centres  <https://www.ghrsst.org/> | |
| Near Real-time Ocean data from the GTS | GTS | Observing System Monitoring Center  <http://osmc.noaa.gov/erddap/> | |
| \_\_\_\_\_\_\_\_\_\_ | | | |

**ACRONYMS**

ACRE Atmospheric Circulation Reconstructions over the Earth

AODN Australian Ocean Data Network

API Application Programming Interface

BUFR Binary Universal Form for the Representation of Meteorological Data

CBS WMO Commission for Basic Systems

Cg WMO Congress

CMOC Centre for Marine Meteorological and Oceanographic Climate data

DAC Data Acquisition Centre

DCPC Data Collection and Production Centre (of WIS)

DMPA JCOMM Data Management Programme Area

DQMS Data Quality Management System

ECV Essential Climate Variable

EOV Essential Ocean Variable

ER Outcome

ERDDAP An specific implementation of data service, see details at

<https://upwell.pfeg.noaa.gov/erddap/index.html>

ETDMP JCOMM-IODE Expert Team on Data Management Practices

ETMC JCOMM Expert Team on Marine Climatology

IPET-MOIS JCOMM Inter Programme Expert Team for Integrated Marine Meteorological and Oceanographic Services within WMO and IOC Information Systems

GDAC Global Data Assembly Centre

GEOSS Global Earth Observation System of Systems

GODAR Global Oceanographic Data Archaeology and Rescue

GOOS Global Ocean Observing System (of IOC, WMO, UNEP, ICSU)

GTS Global Telecommunication System of WMO

ICOADS International Comprehensive Ocean Atmosphere Data Set

ICSU International Council for Science

IMOS Integrated Marine Observing System

IOC Intergovernmental Oceanographic Commission of UNESCO

IODE IOC Committee on International Oceanographic Data and Information Exchange

IQUOD International Quality-Controlled Ocean Database

JCOMM Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology

KO Key Objective

KPI Key Performance Indicator

MCDS Marine Climate Data System

MMOP Marine Meteorology and Oceanography Programme of WMO

MOWIS Marine Meteorological and Oceanographic Services within WIS

NC National Centre (of WIS)

NetCDF Network Common Data Format

OCG Observation coordination Group

ODIS Ocean Data and Information System

ODP IODE Ocean Data Portal

OPA JCOMM Observations Programme Area

OSMC Observing System Monitoring Center

OTGA OceanTeacher Global Academy

QA Quality Assurance

QC Quality Control

SFSPA JOMM Services and Forecasting Systems Programme Area

TT-TDC Task Team on Table Driven Code

UNEP United Nations Environment Programme

UNESCO United Nations Educational, Scientific and Cultural Organization

WIGOS WMO Integrated Global Observing System

WDQMS WIGOS Data Quality Monitoring System

WIS WMO Information System

WMO World Meteorological Organization

WOD World Ocean Database

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1. Eric Freeman (USA, ETMC Chair), Lydia Gates (Germany, ETMC vice-Chair), Nadia Pinardi (Italy, JCOMM Co-President), Sergey Belov (Russia, ETDMP Chair), Sissy Iona (Greece, DMPA Chair), Rabia Merrouchi (Morocco, TT-MOWIS), Emma Heslop (IOC), Peter Pissierssens (IOC/IODE), Etienne Charpentier (WMO), Champika Gallage (WMO) [↑](#footnote-ref-1)
2. [WMO Resolution 40 (Cg-17)](http://www.wmo.ch/pages/prog/www/ois/Operational_Information/Publications/Congress/Cg_XII/res40_en.html) and [WMO Resolution 60 (Cg-17)](https://library.wmo.int/opac/doc_num.php?explnum_id=3138) [↑](#footnote-ref-2)
3. <http://www.iode.org/index.php?option=com_content&view=article&id=51&Itemid=95> [↑](#footnote-ref-3)
4. See list of WMO Application Areas at <https://www.wmo.int/pages/prog/www/OSY/GOS-RRR.html#SOG>. The technology free observational user requirements for those Application Areas are recorded quantitatively (space & time resolution, timeliness, uncertainty, stability) in OSCAR database at oscar.wmo.int. [↑](#footnote-ref-4)
5. WMO Policy and Practice for the Exchange of Meteorological and Related Data and Products Including Guidelines on Relationships in Commercial Meteorological Activities [↑](#footnote-ref-5)
6. WMO Policy for the International Exchange of Climate Data and Products to Support the Implementation of the Global Framework for Climate Services (GFCS) [↑](#footnote-ref-6)
7. WMO Policy and Practice for the Exchange of Meteorological and Related Data and Products Including Guidelines on Relationships in Commercial Meteorological Activities [↑](#footnote-ref-7)
8. WMO Policy for the International Exchange of Climate Data and Products to Support the Implementation of the Global Framework for Climate Services (GFCS) [↑](#footnote-ref-8)
9. [https://coastwatch.pfeg.noaa.gov/erddap](https://coastwatch.pfeg.noaa.gov/erddap/)  [↑](#footnote-ref-9)
10. by integration, it is meant to consider all sources of ocean observations from a variety of observing platform types, weighted according to their quality and relevance. The sources of information may also be of different types, serving data through different mechanism, using different formats, and with various levels of quality control applied and metadata made available. The integration of the data will cope with this variety of sources in the view to make delivery of data to end users as seamless as possible. [↑](#footnote-ref-10)
11. The goal is to cover as many Essential Climate Variables (ECVs) and Essential Ocean Variables (EOVs) as possible [↑](#footnote-ref-11)
12. description of data sets from the perspective of describing geographical information, often based on the ISO 19115 standard. Such metadata are used to make the data-sets discoverable through dedicated informations systems. [↑](#footnote-ref-12)
13. description of processing and history of the data, including about data sources, version, quality assessment and quality control, history and accountability. [↑](#footnote-ref-13)
14. description of the observing platforms and their instruments [↑](#footnote-ref-14)
15. FM 94 - BUFR : Binary Universal Form for the Representation of Meteorological Data, a WMO code used for exchange of data over the Global Telecommunication System (GTS) of the WMO. [↑](#footnote-ref-15)
16. Network Common Data format - <https://www.unidata.ucar.edu/software/netcdf/> [↑](#footnote-ref-16)
17. <https://www.earthobservations.org/documents/dswg/201504_data_management_principles_long_final.pdf> [↑](#footnote-ref-17)
18. Beyond standard VOS; flow water system; can be more than T & S [↑](#footnote-ref-18)