INFORMAL WORKSHOP OF THE META-T PILOT PROJECT STEERING TEAM

(GENEVA, SWITZERLAND, 16-17 SEPTEMBER 2008)

FINAL REPORT

JCOMM MEETING REPORT NO. 60

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

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NOTES

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C O N T E N T S

EXECUTIVE SUMMARY

The informal workshop of the Water Temperature instrument / platform metadata Pilot Project (META-T) Steering Team was held in Geneva, Switzerland, from 16 to 17 September 2008. The aim of the workshop was to review the status of the Pilot Project and implementation of the META-T servers, address metadata streams for specific types of platforms, look at the implications regarding the BUFR templates, and make recommendations and produce and update the Workplan.

The Workshop recommended that the META-T should start investigating whether the full range of variables could be considered in a future platform / instrument metadata collection system, building on the lessons learned from the Pilot Project. At the same time, the National Marine Data and Information Service (NMDIS) in China was invited to consider developing an instrument / platform metadata centre dedicated to all types of in situ ocean observing platforms considered in the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM).

The NOAA National Data Buoy Center (NDBC) in the United States, and NMDIS made substantial progress in developing the two mirror servers although a number of technical aspects still need to be addressed (i.e., updating from the real-time data flow, formats and submission of metadata by the platform operators). The Workshop agreed that the question of long-term archival for the metadata had to be addressed by the JCOMM Data Management Coordination Group (DMCG). Also, the META-T should engage in a closer cooperation with the Open Geospatial Consortium (OGC), the US Integrated Ocean Observing System and in particular, participate in the discussions for the development of sensor interoperability and SensorML. Standards proposed by the META-T will eventually have to be submitted through the JCOMM / IODE Standards Process for wider review and scrutiny. The JCOMM Data Management Programme Area (DMPA) Task Team on Table Driven Codes will follow up on BUFR issues in view of rationalizing all relevant BUFR templates and making them consistent. The lists of metadata for Voluntary Observing Ships (VOS) and Expendable BathyThermographs (XBT) are nearly complete, although some additional review will have to be made in order to take the all of the meeting's recommendations into account. Some work remains regarding the buoy and profiling floats lists. All lists will be reviewed in order to produce a unique list providing information on categorization and use with BUFR.

The Workshop proposed to make a demonstration on progress at JCOMM-III (Marrakech, Morocco, 4-11 November 2009) and recommended to draft a Resolution for the Session, urging platform operators to submit metadata to the system being proposed by the Pilot Project. The Workshop further identified issues that required particular attention, and updated its Workplan accordingly.

The Workshop also proposed to develop a META-T concept of operations using the WMO Integrated Global Observing Systems (WIGOS) as a model. This document will describe the targeted operational system that META-T is proposing to put in place.

Some minor changes were proposed regarding the Terms of Reference (ToR) for the Steering Team. Dr Derrick Snowden was nominated to chair the Steering Team. The full Steering Team will be invited to formalize these arrangements by e-mail correspondence.

GENERAL SUMMARY OF THE WORK OF THE WORKSHOP

1. WELCOME, CALL TO ORDER WORKSHOP INFORMATION AND WORKING ARRANGEMENTS

Mr Bill Burnett, Co-chairperson of the Water Temperature instrument / platform metadata Pilot Project (META-T) Steering Team, opened the workshop at 0900 hours on Tuesday, 16 September 2008. Mr Burnett also chaired the workshop.

2. APPROVAL OF THE AGENDA

The participants approved the agenda for the workshop. The adopted agenda is provided in Annex I to this document. The list of participants is also provided in Annex II.

3. INTRODUCTION AND GOAL OF THE WORKSHOP

3.1 Mr Burnett introduced the goals of the META-T Pilot Project, as well as the goal for the workshop. He recalled that META-T Pilot Project was established by a workshop sponsored by the JCOMM Observations Coordination Group (OCG) (Reading, United Kingdom, 28-29 March 2006).

3.2 The Water Temperature Metadata Pilot Project is aiming at providing an international standardization framework for collecting Sea Surface Temperature (SST) and water temperature profile instrumental metadata from a number of marine observational systems, including drifting and moored buoys, observing ships, sea level stations, sub-surface profiling floats, ocean reference stations, and Ocean Data Acquisition Systems (ODAS).

4. UPDATE ON THE LATEST ACCOMPLISHMENTS OF THE META-T PILOT PROJECT

4.1 The WMO Secretariat presented an overview of the latest progress of the META-T Pilot Project, including:

- Categories of metadata identified;
- Categorization of metadata according to user requirements;
- Compilation of metadata lists for specific platform types (VOS, XBT);
- Recommendations made for inclusion of specific metadata fields in real-time BUFR GTS reports (buoys, XBT); and
- Development of dedicated servers at NMDIS and NOAA / NDBC.

4.2 More information on the status of the Pilot Project is provided in Annex III.

5. DESCRIPTION OF THE META-T SERVERS AT NMDIS AND NDBC

5.1 Ms Jixiang Chen (NMDIS) presented an overview of the META-T server and facilities currently being developed at NMDIS.

5.2 Mr Burnett presented an overview of the META-T server and facilities presently being developed at NOAA / NDBC.

5.3 Results and recommendations arising from those discussions and those from the forthcoming agenda items are summarized in Annex IV.

6. REVIEW OF THE LATEST META-T DOCUMENTATION AND EDIT

The Workshop reviewed the META-T Workplan and schedule. It also reviewed existing documentation produced by the Pilot Project and suggested changes as necessary. In particular, it reviewed the metadata categorization, and the lists of Category 1 metadata proposed for the VOS and XBT data.

7. DEVELOPMENT OF ADDITIONAL DOCUMENTATION

7.1 The Workshop discussed additional documentation which will be required for the further development of the Pilot Project. This documentation includes, in particular, refining the lists of Category 1 metadata for moored buoy, drifting buoys, profiling floats, and any other additional data streams as required.

7.2 The META-T Pilot Project has defined three categories of metadata. The Pilot Project has also identified different requirements for metadata and proposed a matrix showing for each application which metadata from each category are required. Based on this matrix, a generic categorization was proposed (i.e. what type of metadata to be included in each category). Details concerning this proposal are provided in Annex V.

8. OTHER PROJECT RELATED TO META-T

8.1 The Workshop addressed other projects which relate to the META-T. In particular, the IODE / JCOMM Forum on Oceanographic Data Management have established a standards process where the META-T can potentially provide substantial input.

8.2 Mr Burnett reported on the requirements from the Quality Assurance of Real-Time Ocean Data (QARTOD – USA) and on the QARTOD to Open Geospatial Consortium (Q2O), and how QARTOD relates to the META-T.

8.3 Mr Robert Keeley, Chairperson of the JCOMM Data Management Coordination Group (DMCG), presented the WMO Integrated Global Observing Systems (WIGOS) and the development of a WIGOS Pilot Project for JCOMM. The Workshop agreed that the META-T could contribute to the WIGOS by developing interoperability arrangements between the META-T servers and the WIS, and by integrating the platform / instrument metadata collection system into the overall WIGOS best practices framework.

9. UPDATE ON NMDIS ODAS CAPABILITIES

Ms Chen reported on the development of the JCOMM ODAS Metadata Service (ODASMS) and how it relates to the META-T server, which was also developed by China.

10. FUNDING OF REQUIRED DEVELOPMENTS

10.1 The Workshop addressed funding requirements for the Pilot Project. It noted that the United States had secured funding for 70% of the project for developing the META-T server. Some additional software developments will be needed to extract the metadata from the BUFR reports and encode them as appropriate. Mr Burnett will make a cost estimate and seek funding as appropriate (**Action, B. Burnett, ASAP**).

10.2 China committed to make the required developments for the META-T server.

10.3 The Workshop thanked the NMDIS and NOAA / NDBC (USA) both for their commitments to the project.

11. FUTURE MEMBERSHIP OF THE META-T PILOT PROJECT

11.1 The Workshop proposed to slightly revise the Steering Team Terms of Reference (ToR). It reviewed the Membership of the Steering Team, and noted that Ms Elanor Gowland was no longer in a position to co-chair the Team. Mr Burnett therefore resigned as Chairperson, and the Workshop proposed to elect Dr Derrick Snowden as Chairperson of the META-T Steering Team.

11.2 The Workshop further proposed additions to the membership of the Steering Team. The WMO Secretariat was tasked to contact the full Steering Team and seek its agreement regarding the new Terms of Reference, membership, and leadership (**Action, WMO Secretariat, October 2008**). At the same time, the WMO Secretariat should ask existing members whether they want to continue to participate as an active member of the Steering Team, and existing contact points whether they wished to remain in the mailing list. The proposed changes are reflected in Annex VI.

12. PILOT PROJECT SPECIFICATIONS, WORKSHOP RECOMMENDATIONS AND ACTION PLAN

12.1 The recommendations from the workshop are provided in Annex IV. The new Pilot Project Workplan is provided accordingly in Annex VII.

12.2 The Workshop agreed that most of the discussions required to make progress on the Workplan could be realized by e-mail correspondence. If the need arises, the Steering Team may eventually decide to call for a meeting before JCOMM-III (Marrakech, Morocco, 4-11 November 2009).

12.3 The Workshop closed at 1600 hours on Wednesday, 17 September 2008.

ANNEX I

Workshop of the META-T Steering Team
Geneva, Switzerland, 16 - 17 September 2008

AGENDA

1. WELCOME, CALL TO ORDER, WORKSHOP INFORMATION AND WORKING ARRANGEMENTS
2. APPROVAL OF THE AGENDA
3. INTRODUCTION AND GOAL OF THE WORKSHOP
4. UPDATE ON THE LATEST ACCOMPLISHMENTS OF THE META-T PILOT PROJECT
5. DESCRIPTION OF THE META-T SERVERS AT NMDIS AND NDBC
6. REVIEW OF THE LATEST META-T DOCUMENTATION AND EDIT
   - 6.1 META-T Workplan and Schedule
   - 6.2 Metadata categorization and requirements Matrix, v2
   - 6.3 META-T Table for VOS
   - 6.4 META-T Table for XBT
7. DEVELOPMENT OF ADDITIONAL DOCUMENTATION
   - 7.1 META-T Table for Moored Buoys
   - 7.2 META-T Table for Drifting Buoys
   - 7.3 META-T Table for Floats
   - 7.4 Additional Tables
8. OTHER PROJECTS RELATED TO THE META-T
   - 8.1 IODE / JCOMM Forum on Oceanographic Data Management
   - 8.2 Quality Assurance of Real-Time Ocean Data (QARTOD – USA)
   - 8.3 QARTOD to Open Geospatial Consortium (Q2O – USA)
   - 8.4 WIGOS Pilot Project for JCOMM
   - 8.5 Additional Projects
9. UPDATE ON NMDIS ODAS CAPABILITIES
10. FUNDING OF REQUIRED DEVELOPMENTS

11. FUTURE MEMBERSHIP OF THE META-T PILOT PROJECT

12. PILOT PROJECT SPECIFICATIONS, WORKSHOP RECOMMENDATIONS AND ACTION PLAN

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ANNEX II

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ANNEX III

CURRENT STATUS OF THE PILOT PROJECT

(as of 1 September 2008)

1. The third session of the JCOMM Data Management Coordination Group (Ostend, March 2008) noted with appreciation that the META-T Pilot Project has made some progress in recent months (http://marinemetadata.org/meta-t). Mr Bill Burnett (NOAA/NDBC) has been elected to co-chair the META-T Steering Team in collaboration with Ms Elanor Gowland (UK Met Office). The META-T has had active discussions on what information is required to travel with the data, what is relatively static, and what data can be housed and referenced separately. The work of META-T crosses over into Ocean Data Acquisition Systems (ODAS) metadata developments, as a database of ODAS metadata (instrument characteristics) is being hosted at the National Marine Data and Information Service (NMDIS, China). The META-T also links to the further development of BUFR templates, as it is partly through these templates that the metadata will be transmitted with the data. Currently, there are active e-mail discussions between members of the JCOMM Observations and the Data Management Programme Areas (DMPA), the WMO Secretariat and input from the CBS Expert Team on Data Representation and Codes (ETDRC).

2. The Water Temperature metadata pilot project is aiming at providing an international standardization framework for collecting SST and water temperature profile instrumental metadata from a number of marine observational systems, including drifting and moored buoys, observing ships, sea level stations, sub-surface profiling floats, ocean reference stations, and ODAS. It is being developed under the umbrella of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM).

3. The Project is considering all in situ ocean observing systems providing water temperature data in real-time and / or delayed-mode to the operational and research, oceanographic and meteorological communities. These include drifting and moored buoys, ship-based observations, including from Ships of Opportunity (SOO), Argo profiling floats, tide gauges, Ocean Data Acquisition Systems, deep-ocean timeseries reference stations (OceanSITES), etc. Collected metadata are addressing a wide range of applications including Numerical Weather Prediction (NWP), SST analysis and GODAE High-Resolution SST Pilot Project (GHRSST), data assimilation and ocean field analysis, ocean modeling, ocean modeling validation, climate forecast, seasonal to decadal climate variability, satellite calibration and validation, operational activities (e.g., weather forecasters, disaster response), quality assurance activities serving above applications, and diagnostic by platform operators.

4. The Pilot Project has proposed three categories for the instrumental metadata from the types of platforms currently under consideration: 1) real-time with observations (push); 2) real-time via metadata servers (pull), and 3) delayed-mode, as well as the mechanisms to make the SST and / or temperature profile metadata available in real-time. The NOAA National Data Buoy Centre (NDBC), United States, and the NMDIS, China, have offered to develop and run mirrored metadata servers for Category 2 metadata. Much work remains to set up the META-T servers at both the NMDIS and NDBC, and they have agreed on the communication between the two centres for mirroring the metadata servers (Categories 1 and 2 metadata). The DMCG-III (Ostend, Belgium, 26-28 March 2008) noted that the Category 1 metadata were by definition available via the observational reports (e.g., probe type in XBT, call sign, kind of profiling float) and that the main challenge for the end-users was therefore accessing Category 2 metadata. The DMCG-III invited NMDIS and NDBC to address collecting Category 2 metadata as a priority, while Category 1 metadata can still be made available via the META-T servers.

5. Specific data streams have been considered (e.g., drifting buoys, ships, floats, etc.) and the categorization of related metadata types initiated. Substantial progress has been made regarding the VOS data stream and the list of Category 1 metadata for the VOS template is completed. The DMCG-III agreed with the VOS list proposed by META-T. The XBT Fall Rate

Workshop (Miami, USA, 10-12 March 2008) discussed META-T requirements for XBT data, including for BUFR template, and has set up a small task team who succeeded in developing an appropriate list of metadata.

6. The META-T now appears to be in a position to make recommendations to the JCOMM cross-cutting Task Team (TT) on Table Driven Codes (this TT is currently being formed) in order to take the META-T requirements for Category 1 metadata into account when defining requirements for the BUFR templates for VOS and XBT data.

7. However, just the process of developing and reviewing the VOS list within META-T has highlighted these interrelated issues:

(i) High complexity and some apparent inflexibility in BUFR, which has hampered to some extent wide and effective review by users involved in META-T; and

(ii) Possible need for a more structured and inclusive review process, to ensure that any BUFR templates approved in the future have been fully vetted. This includes assessment of potential impacts (both positive and negative) on the climate record of any format changes (possibly also involving ETMC), and agreement about how those considerations are weighed in the approval process both within and externally to JCOMM.

8. The DMCG-III requested the WMO Secretariat to contact the SOT and DMCG codes groups, and to suggest that they consider ship metadata proposed by META-T in the development of proposals for ship BUFR templates.

9. The META-T now needs to select other types of platform (i.e., another data stream, buoys, floats, OceanSITES, tide gauges, or other types of ODAS) for which to develop a similar list of metadata.

10. An oral presentation on META-T was made at the CLIMAR-III Workshop (Gdynia, Poland, 6-9 May 2008), for stimulating some useful feedback from the climate research and wider data management communities. The results and recommendations based on the META-T work should also be presented to JCOMM-III (Marrakech, Morocco, 4-11 November 2009). The DMCG-III invited the NMDIS and NDBC to prepare a presentation of META-T and META-T server for JCOMM-III.

11. The DMCG-III requested that the NMDIS and NDBC discuss real-time receiving and updating mechanisms for the META-T. The NMDIS proposed to receive and update metadata on a daily basis in text or XML format through FTP on the Internet, so as to ensure the consistency of the data that reside on both the NMDIS and NDBC servers accordingly.

ANNEX IV

RECOMMENDATIONS FROM THE WORKSHOP

1. SCOPE OF THE META-T

1.1 Considering that the META-T was already looking at a wide spectrum of types of platforms (i.e., drifters, moorings, ODAS, VOS, SOOP ships, tide gauges, Argo floats, OceanSITES, etc.) and that the number of oceanographic variables being considered within JCOMM was relatively limited, the Workshop considered whether to expand its scope beyond SST and Water Temperature and include the full spectrum of variables to address operational and research requirements for climate applications; NWP, Ocean Mesoscale Forecast, and Marine Services. The Workshop agreed that this was premature at this point, but that the issue should be reconsidered once appropriate progress to install and successfully operate the initial service was made.

1.2 On one hand, the NMDIS is addressing the ODAS and on the other hand, the META-T. However, most of the platform metadata collected under the ODASMS are more relevant to the META-T than the ODAS because the ODASMS is collecting metadata for tide gauges, drifting buoys, and Argo floats which are not regarded as ODAS. The relevant marine ODAS types include: lighthouses and light vessels, observing towers and platforms, oil rigs, land-based automatic stations which have been allocated international ocean data buoy identifier numbers (or national identification numbers, as is the case with Coastal-Marine Automated Network [C-MAN] reports from NDBC), ice drift buoys and buoys mounted on ships. The DMCG-III endorsed the following ETMC-II recommendation for adoption by JCOMM-III: for rigs and platforms, manual observing-systems should be treated as a “ship” and their metadata included in the Pub. 47; automated systems onboard rigs and platforms should be treated as a “buoy” and their metadata included in the ODASMS. The NMDIS is invited to consider transitioning the ODASMS+META-T into a more general JCOMM Metadata Service for ocean observing platforms (to address platform types not covered by ODASM, and to address variables not presently covered by META-T) (**Action, NMDIS, 31 October 2008**). Considering the emphasis placed on implementing an initial service, the NMDIS, in consultation with the NDBC, is asked to respond with a proposal for a more general metadata service early in the third quarter of 2009. If agreed by the NMDIS, considering the META-T developments, and demonstration made at the Session, a JCOMM-III Resolution could be proposed for urging Members to comply with the newly proposed metadata collection system and routinely contribute metadata to NMDIS and NDBC. This proposal would first have to go through the DMCG by e-mail correspondence, and the JCOMM Management Committee (MAN) (**Action, R. Keeley, November 2008**). The NMDIS shall inform the Chairpersons of the META-T and DMCG regarding their possible proposal(s).

2. DEMONSTRATION

2.1 The Pilot Project needs to begin monitoring the metadata that are actually being collected from this point forward. This data will help demonstrate progress. Historical metadata can also gradually be included. The Meeting agreed that this could be accomplished by the NDBC beginning to extract metadata from surface drifter reports delivered in BUFR and by the NMDIS extracting metadata from the available netCDF files at the Argo GDACs. Implementing the extraction of metadata from these two sources, insertion into the metadata servers, mirroring across the two servers, and providing some metadata serving capabilities would be sufficient for a useful JCOMM-III demonstration.

2.2 WMO Publication No. 47 (Pub 47) includes information about recruited VOS. The Publication is managed by the WMO Secretariat, and updated on a quarterly basis, thanks in large part to submissions made by WMO Members to the WMO Secretariat. This information is available on-line and can be located at the following web address (insert as appropriate). Pub 47 is a mandatory publication, and specific policy applies with regard to its distribution. The Workshop

noted that Pub 47 was already being routinely loaded in the OSMC at the NDBC. The SOT needs to address Pub 47 in light of META-T developments (i.e., how Pub 47 can feed into the META-T servers, and how to address the real-time metadata issue). For example, the JCOMMOPS also maintains a list of masked ship's call signs versus real call signs. The SOT might consider new recommendations, e.g., shall the META-T servers include additional information that does not necessarily appear in the Pub 47? Shall the JCOMMOPS also be responsible for collecting VOS metadata in a timelier manner? Are there new metadata fields that should be added in Pub 47 to meet META-T requirements?

2.3 A report by META-T on progress and VOS issues needs to be presented at SOT-V (**Action, R. Keeley, February 2009**).

2.4 The Workshop agreed that a demonstration was needed for JCOMM-III (Morocco, November 2009) to show to the Technical Commission what has been accomplished and what could practically be developed further; this would include showing examples of metadata collected in real-time and through the server for specific types of platforms and metadata availability maps to show discrepancies between the networks and metadata actually collected (**Action, R. Keeley, November 2009**). Some examples of applications that have been using the metadata will also be useful.

3. BUFR TEMPLATES

3.1 The BUFR template for buoy data needs to be reviewed and specific metadata extracted from it, and categorized for inclusion in the META-T list of metadata (**Action, H. Viola, November 2008**). The NDBC offered, in consultation with ISDM, to make the necessary software developments to extract in real-time relevant META-T metadata from decoded BUFR reports collected in real-time from the GTS at NDBC and feed the META-T server accordingly (**Action, NDBC, ASAP**). The Data Buoy Co-operation Panel (DBCP) should urge buoy operators to submit the metadata to JCOMMOPS (**Action, DBCP-XXIV, October 2008**). The JCOMMOPS must also update its ftp site routinely and keep it operational (most current data are from July 2007) (**Action, H. Viola, ASAP**).

3.2 The Workshop agreed that there was a need to rationalize the BUFR templates amongst themselves so that they become more consistent, in particular, when addressing specific ocean variables. Dr Derrick Snowden (NOAA / OCO) was designated to participate in the DMPA Task Team on Table Driven Codes in order to bring the Pilot Project's perspective into account when developing new integrated templates for ocean data. The Workshop further recommended that DMPA consolidates the Task Team membership and makes progress on rationalization (**Action, R. Keeley and D. Snowden, ASAP**).

3.3 The Workshop expected that the OGC would eventually provide the metadata standard for the delivery of Categories 2 and 3 metadata by platform operators, and that BUFR becomes the standard for Category 1 metadata distributed and collected in real-time.

3.4 Regarding BUFR, a two-step approach was proposed:

- Step 1: Finalize the XBT BUFR template. USA to start dissemination of VOS and XBT data in BUFR with appropriate metadata as part of the demonstration (**Action, USA, ASAP**).

- Step 2: Rationalize the BUFR templates for all relevant platform types. META-T to relay requirements on T and SST to the DMPA Task Team on Table Driven Codes which will in turn will go beyond the current BUFR templates and beyond T and SST and rationalize templates (new sets of variable-based templates to be eventually proposed) (**Action, DMPA TT TDC, ASAP**)

3.5 Some rationalization is needed for submitting Categories 2 and 3 metadata to the servers, including formatting, policies and incentives. While noting that the NMDIS had defined an input format for ODASMS, the NMDIS and NDBC were asked to make a proposal that would take the OGC standards and related developments into account (e.g., Observation schema, SensorML) (**Action, NDBC and NMDIS, end 2008**).

3.6 The GCCs were asked to investigate whether additional VOS Category 2 metadata could be provided to the META-T servers (**Action, N. Scott, October 2008**).

4. DATA STREAMS AND METADATA LIST

4.1 There is a need to develop one META-T list of metadata showing BUFR requirements, and Categories 1, 2, and 3 requirements for each metadata to be considered. The list can be broken down by platform type of measured variable. A matrix with metadata versus platform types needs to be developed. The WMO Secretariat shall provide the list of BUFR templates to Mr Bill Burnett for review purposes and identification of appropriate metadata fields to be included in the list.

4.2 Only metadata that are not varying in time (or rarely varying during the platform's lifetime) should be considered by META-T. Other metadata and data will eventually appear in the operational dataflow anyway (e.g., BUFR). All metadata that META-T previously considered as belonging to Category 1 should appear in BUFR templates. All metadata that appear in the BUFR templates and are varying in time should not appear in the META-T list of Category 1 metadata. The DMCG, in consultation with the META-T should address the issues of long-term archiving in all relevant archiving centres of all metadata fields that appear in the BUFR reports (**Action, R. Keeley, February 2009**).

4.3 Metadata records for META-T should be identified by the following: identification number and period during which the record is valid (and the metadata constant). In addition, the first date / time / location, and the most recent should also appear in the metadata record.

4.4 The Workshop agreed that there was a need to review the VOS and XBT tables again and merge them into the META-T list of metadata to include the following additions: new BUFR column added (yes / no) and content of the META-T column to be reviewed (no / 1 / 2 / 3). The rules: (i) Existing "1" in META-T column to become "yes" in the BUFR column; (ii) BUFR templates to be reviewed and appropriate metadata fields added if needed (with yes in the BUFR column); and (iii) for every line where there is a "yes" in the BUFR column, identify what value (no / 1 / 2 / 3) to put in the META-T column (should be no if the metadata is varying in time). New VOS and XBT lists should be circulated to the larger META-T Steering Team (**Action, D. Snowden, October 2008**).

4.5 The Workshop recommended that the SOT address the issue of using IMO numbers as unique identification numbers instead of ITU call signs. It asked the WMO Secretariat to raise the issue at SOT-V (Geneva, Switzerland, 18-22 May 2009) (**Action, WMO Secretariat, May 2009**). The Workshop also noted that the issue also linked with the ship masking issue and the work of the SOT Task Team in this regard.

4.6 The Argo Technical Co-ordinator, Mr Mathieu Belbeoch, was invited to look at the NetCDF, BUFR, and AIC database and propose a META-T list of metadata Categories 1 and 2 that comply with the rules defined by the META-T (**Action, M. Belbeoch, November 2008**).

5. SERVERS

5.1 It is not the role of the META-T servers to hold the historical metadata. These should eventually be submitted routinely to the appropriate archives or such centres will have to be identified. The META-T should be seen as a metadata collection mechanism only. The META-T is defining a metadata collection mechanism through: (i) getting metadata in real-time via BUFR; and (ii) coordination mechanisms and human resources (i.e., JCOMMOPS, then OPSC) directly liaise

with the platform operators so that they make sure that the Category 1 metadata are being provided in the real-time reports on one hand, and the Category 2 metadata are being submitted through the appropriate channels on the other hand. In this regard, as much metadata as possible must be put in the BUFR templates.

5.2 Services to be developed could include: (i) web-based query form on the servers; (ii) URL that includes the identification number returning a page with all available metadata; and (iii) XML files available on FTP.

5.3 Mirroring: The Workshop recommended that the NMDIS and NDBC routinely and operationally inform each other about new records submitted (**Action, NDBC and NMDIS, ongoing**). Routine and regular metadata updates are to be exchanged between them accordingly.

5.4 The NDBC and NMDIS are to start populating the servers, based on available information: (i) metadata from the real-time data flow; and (ii) metadata from platform operators (e.g., SEAS), JCOMMOPS (buoys, XBTs), Argo GDACs, GLOSS and SOOPIP. All platform operators are to be approached in order to urge them to submit the metadata more often to JCOMMOPS.

6. LONG-TERM ARCHIVES

6.1 The Workshop agreed that there was a need to identify the final long-term archive for the META-T metadata. The Workshop also agreed that the NDBC and NMDIS were not necessarily in the best position to provide for the long-term archive of the data although they might wish to engage into discussions nationally to address the issue. The long-term archives should have access to the metadata being collected through META-T, including through the real-time data stream, and at the same time provide for appropriate metadata distribution mechanisms. The Workshop asked the DMCG to address the issue accordingly (**Action, DMCG, 28 February 2009**).

7. QUALITY ISSUES

The Workshop agreed that quality issues could not be addressed at this point. The system needs to be up and running first; then, quality issues will be identified.

8. INVOLVEMENT WITH OTHER PROJECTS

8.1 Ocean Data Portal (ODP) and WMO Integrated Global Observing Systems (WIGOS), Messrs Greg Reed and Robert Keeley presented an overview of the ODP and WIGOS Pilot Project for JCOMM, respectively. The META-T will eventually contribute instrument / platform metadata (seen as data in this context) and related discovery metadata to the Ocean Data Portal and WIGOS. Most of the required discovery metadata for META-T are actually included in the META-T platform / instrument metadata and those developing the META-T servers will have to work at developing tools for producing and making routinely available the ODP-WIS metadata.

8.2 With regards to the JCOMM / IODE standards process, Mr Robert Keeley presented the recent developments. The Workshop recommended that standards proposed by the META-T should eventually be submitted through the JCOMM/IODE Standards process for review in the wider community and for promoting wider acceptance (**Action, D. Snowden, March 2009**).

8.3 Mr Bill Burnett, Co-chairperson of the META-T Steering Team, presented the NOAA IOOS Program, and provided an overview of the Data Integration Framework (DIF) project. Mr Burnett then reported on NDBC ocean data management activities that more or less related to the META-T including:

- HF Radars;
- SOS;

- QARTOD, and Q2O (QARTOD to operations);

- OSMC has tools to display data and metadata; and

- SensorML, and Sensor Web Enablement (SWE). These are being followed by the OGC. The Steering Team agreed that getting the metadata directly from the sensors through SensorML could be an appropriate solution for contributing to the META-T efforts. In this regard, the META-T must ensure that the META-T fields are included in SensorML (via IOOS then OGC) (**Action, B. Burnett, December 2008**). The SensorML should be treated in a similar way as what the META-T Pilot Project has been doing with BUFR.

9. DOCUMENTATION

9.1 The Workshop discussed documentation issues and agreed that: (i) the specific data streams documents should be updated; and (ii) a single document describing and synthesizing all the considered data streams should be drafted and circulated to the Steering Team (**Action, B. Burnett, October 2008**).

9.2 The Workshop also recommended producing a "META-T Concept of Operations" that would describe the targeted operational system that META-T is proposing to put in place. The document should include: goals, requirements, benefits, mechanisms, actors (including information about the long-term archiving centres), risk factors, etc. The Workshop invited Dr Derrick Snowden to draft the document (**Action, D. Snowden, 28 February 2009**). The "META-T Concept of Operations" will eventually contribute to the JCOMM data cookbook to be submitted to JCOMM-III (**Action, R. Keeley and C. Clark, March 2008**).

ANNEX V

CATEGORIZATION OF METADATA

CATEGORIES OF METADATA

The following categories of metadata are being considered:

Category 1: Metadata required by operational users for real-time distribution within observational reports. Observational reports include identification, observation date / time, location, sensor values, and Category 1 metadata. Observational reports include GTS reports such as BUFR, BUOY, BATHY, TESAC, or SHIP, as well as reports distributed in real-time through other means, e.g., netCDF reports.

Under Category 1, the following sub-categories can be proposed based on delivery techniques being used:

Category 1.a: Metadata transmitted directly by the ocean platform (e.g., from the deck of the ship for a VOS) along with its observations and added to the real-time observational reports (BUFR, netCDF, SHIP, etc.).

Category 1.b: Metadata not transmitted directly by the platform but known by the platform operator and added on-shore to the real-time observational reports after appropriate data processing (e.g., added in real-time to SHIP or BUFR reports before actual GTS insertion).

Category 2: Metadata of Category 1 plus metadata required by users in real-time but obtained separately from the observations. Such metadata will not appear in the GTS or netCDF reports but platform operators should make them available as soon as possible after platform deployment to the servers for real-time access from there.

Category 3: Metadata of Categories 1 and 2, plus metadata not required by the operational users. These typically include metadata useful for scientific purposes.

All categories of metadata should eventually reach the dedicated metadata server(s). Distribution mode is detailed below.

- Category 1 metadata require encoding in appropriate observational reports. BUFR and NetCDF formats are recommended format. Category 1 metadata should be collected by dedicated metadata server(s) from the GTS and from dedicated data systems (e.g., Argo, OceanSITES, GOSUD) for distribution;

- Category 2 metadata should be made available to the servers by platform operators as soon as possible after operational deployment of observing platforms. Formats in which to make the metadata available still needs to be defined by the META-T Pilot Project after careful consideration of existing standards (e.g., MarineXML, ISO 19115 (using ISO 19139)); and

- Category 3 metadata can be made available to the servers after the start of the platform operational life-time. Formats in which to submit the metadata will be defined by the META-T Pilot Project.

However, Categories 1b and 2 could be combined depending on the method of delivery of the information (i.e., if 1b is not via the GTS but pulled from a centralised server by the user).

The following user requirements are being considered by META-T: (i) data assimilation and ocean field analysis; (ii) ocean modelling; (iii) ocean modelling validation; (iv) climate

forecasting; (v) seasonal to decadal climate variability; (vi) numerical weather prediction; (vii) satellite calibration; (viii) satellite validation; (ix) SST analysis; (x) operational activities (e.g., weather forecasters, disaster response); (xi) quality assurance activities serving above applications, and (xii) diagnostics for platform operators.

CATEGORIZATION

From the user requirements matrix, the categorisation of metadata types has been proposed, where the fields appear in the earliest section they are mentioned, so the information is provided in time for all users:

Category 1:

- Operational state of platform (e.g., state of ship);
- Platform type (e.g., moored buoy, drifter, VOS ship, SOOP ship, Research Vessel, profiling float, ODAS);
- Instrument type (e.g., manufacturer);
- Instrument height or depth (e.g., relative to agreed standard);
- Quality information;
- Data QC'ed indicator (y / n);
- Data modified indicator (y / n);
- Sampling intervals and schemes;
- Averaging schemes;
- Unique tag (e.g., CRC);
- Instrument behaviour (e.g., fall rate equation); and
- Housekeeping parameter (e.g., battery voltage).

Category 2:

- Platform characteristics (e.g., size, dimensions, manufacturer);
- Assumed instrument performance / resolution / precision Instrument calibration status;
- Instrument location information;
- Period of validity of metadata;
- Information regarding data centre processing the data;
- Location of further information (e.g., photos, drawings);
- Data management information (e.g., creation date, update date);
- Data telecommunication system (e.g., Argos, Iridium, Code 41); and

- Type of algorithm used to convert the data.

Category 3:

- Operator of platform or instrument;
- Global programme in which platform is participating (e.g. Argo, VOS);
- Date of last useful transmission; and
- Post-Calibration information.

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ANNEX VI

PROPOSED NEW TERMS OF REFERENCE AND MEMBERSHIP OF THE STEERING COMMITTEE FOR THE WATER TEMPERATURE INSTRUMENT / PLATFORM METADATA PILOT PROJECT (META-T)

(Draft, as of September 2008)

The Pilot Project is to demonstrate feasibility of international access to a comprehensive and up-to-date marine temperature metadata.

The Steering Team shall be selected and tasked to guide the Pilot Project through the following actions:

(i) Liaise with existing marine metadata projects to develop support for the goals of the Pilot Project (e.g., ODAS, IODE, WIS, ODP-WIGOS);

(ii) Refine the list of user requirements and use cases to consider in the context of the Pilot Project;

(iii) Finalize the list of metadata, its categorization and relationships, to meet user requirements;

(iv) Liaise with relevant task teams and working groups to ensure that required metadata for distribution along with the observation can be properly encoded in BUFR reports or other relevant formats;

(v) Consider extension to other variables than sea temperature data;

(vi) Address format issues and seek wide acceptance by the ocean observing community (e.g., OGC, ISO standards);

(vii) Facilitate distribution of the metadata to the pilot project data centers, through liaison with relevant observing programmes;

(viii) Encourage the development of tools to access the metadata; and

(ix) Suggest other actions to advance the integration and timeliness of marine metadata availability.

Membership:

The Steering Team shall include, to the greatest extent feasible, participants from the affected and interested marine community groups. Names are to be determined.

Name:	**Representing:**	**Comment:**
Derrick Snowden	NOAA / OCO	Chairperson
Nicola Scott	Global Collecting Centres	META-T PP
Bill Burnett	TAO, NDBC metadata server	META-T PP
Candyce Clark	JCOMM OPA	or her recommendation
Lin Shaohua	NMDIS metadata server	or her recommendation
Robert Keeley	JCOMM / DMPA, IODE	or his recommendation
Greg Reed	IODE	
Craig Donlon	JCOMM/SPA, GHRSST, GODAE	
Ed Harrison	OOPC	
David Meldrum	DBCP	and / or TC / DBCP, Hester Viola

Graeme Ball	SOT	
Elizabeth Kent	VOS / VOSClim	
Gustavo Goni	SOOPIP	
Pierre-Yves Le Traon	GODAE	
Thierry Carval	GOSUD, GTSPP, OceanSITES, Argo	
Tom Smith	SST Analysis	to be confirmed
Milan Dragosavac	WIS, NWP	
Neville Smith	Ocean Analysis	or his recommendation
Mathieu Belbeoch	AIC, JCOMMOPS	
Don Collins Luis Bermudez John Graybeal WIS contacts	Metadata experts	

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ANNEX VII

META-T WORKPLAN

Task	**Ref (Annex IV)**	**By**	**Deadline**
To consider transitioning the ODASMS+META-T into a more general JCOMM Metadata Service for ocean observing platforms	1.2	NMDIS	31 October 2008
To develop a proposal for a JCOMM-III Resolution	1.2	R. Keeley	November 2008
To present a META-T report on progress and VOS issues for presentation at SOT-V	2,3	R. Keeley	February 2009
To prepare a demonstration for JCOMM-III	2.1, 2.4	R. Keeley	November 2009
To review the BUFR template for buoy data and extract / categorize specific metadata from it	3.1	H. Viola	November 2008
To make the necessary software developments to extract in real-time relevant META-T metadata from decoded BUFR reports collected in real-time from the GTS at NDBC and feed the META-T server accordingly (in consultation with ISDM)	3,1	NDBC	ASAP
To urge buoy operators to submit the metadata to JCOMMOPS	3.1	DBCP-XXIV	October 2008
To update JCOMMOPS ftp site routinely and keep it operational	3.1	H. Viola	ASAP
To rationalize BUFR Templates	3,2 & 3.4	R. Keeley and D. Snowden	ASAP
To finalize the XBT BUFR template and USA to start dissemination of VOS and XBT data in BUFR	3.4	USA	ASAP
To make a proposal for metadata Categories 2 and 3 submissions that would take the OGC requirements into account	3,5	NDBC and NMDIS	end 2008
To investigate whether additional VOS Category 2 metadata could be provided to the META-T servers	3.6	N. Scott	October 2008
DMCG to address the issue of long term archiving in all relevant archiving centres of all metadata fields that appear in the BUFR reports	4.2 & 6.1	R. Keeley	February 2009
To circulate new VOS and XBT lists to the larger META-T Steering Team	4.4	D. Snowden	October 2008
To raise the issue of using IMO numbers as unique identification numbers instead of ITU numbers at SOT-V	4.5	WMO Secretariat	April 2009
To look at the NetCDF, BUFR, and AIC database and propose a META-T list of metadata Categories 1 and 2 that comply with the rules defined by the META-T	4.6	M. Belbeoch	November 2008
To routinely and operationally inform each other (i.e., NDBC and NMDIS) about new records submitted	5.3	NDBC and NMDIS	Ongoing

To submit META-T standards through the JCOMM / IODE Standards process	8.2	D. Snowden	March 2009
To ensure that the META-T fields are included in SensorML (via IOOS then OGC)	8.3	B. Burnett	December 2008
To update data stream documentation and produce a single synthetic document	9.1	B. Burnett	October 2008
To draft a “META-T Concept of Operations”	9.2	D. Snowden	28 February 2009
To include the “META-T Concept of Operations” in the JCOMM data cookbook	9.2	R. Keeley and C. Clark	March 2008

ANNEX VIII

ACRONYMS

Argo	International Argo profiling float Programme (not an acronym)
BUFR	Binary Universal Form for the Representation of meteorological data (FM 94–XI Ext. BUFR)
CLIMAR	JCOMM Workshop on Advances in Marine climatology
DIF	Data Integration Framework
DMCG	JCOMM Data Management Coordination Group
DMPA	JCOMM Data Management Programme Area
ET-DRC	CBS Expert Team on Data Representation and Codes
ETMC	JCOMM Expert Team on Marine Climatology
FTP	File Transfer Protocol
GDAC	Global Data Acquisition Centre
GHRSST	GODAE High-Resolution SST Pilot Project
GLOSS	Global Sea-level Observing System
GODAE	Global Ocean Data Assimilation Experiment
IMO	International Maritime Organization
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IODE	International Oceanographic Data and Information Exchange (of IOC)
IOOS	Integrated Ocean Observing System (USA)
JCOMM	Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
JCOMMOPS	JCOMM in situ Observing Platform Support Centre
MAN	JCOMM Management Committee
META-T	Water Temperature instrument / platform metadata Pilot Project
NDBC	NOAA National Data Buoy Center (USA)
NetCDF	Network Common Data Form
NMDIS	National Marine Data and Information Service (China)
NOAA	National Oceanic and Atmospheric Administration (USA)
NWP	Numerical Weather Prediction
OceanSITES	OCEAN Sustained Interdisciplinary Timeseries Environment observation System
OCG	JCOMM Observations Coordination Group
ODAS	Ocean Data Acquisition Systems
ODASMS	JCOMM ODAS Metadata Service
ODP	Ocean Data Portal
OGC	Open Geospatial Consortium
OPSC	WMO-IOC Observing Programme Support Centre
OSMC	Ocean Observing System Monitoring Centre
Pub 47	WMO Publication No. 47
QARTOD	Quality Assurance of Real-Time Oceanographic Data
SEAS	Shipboard Environmental (data) Acquisition System
SensorML	OpenGIS® Sensor Model Language Encoding Standard (OGC)
SOOP	Ship of Opportunity Programme
SOOPIP	Ship of Opportunity Programme Implementation Panel
SST	Sea Surface Temperature
URL	Uniform Resource Locator
VOS	Voluntary Observing Ship
WIGOS	WMO Integrated Global Observing Systems
WMO	World Meteorological Organization
XBT	Expendable BathyThermograph
XML	Extensible Markup Language