WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

DATA BUOY COOPERATION PANEL

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TWENTY-NINTH SESSION

ITEM: 6.3

PARIS, FRANCE
23-17 SEPTEMBER 2013

ENGLISH ONLY

REPORT BY THE TASK TEAM ON MOORED BUOYS (TT-MB)

(Submitted by Jon Turton, TT-MB Chair, United Kingdom)

Summary and purpose of the document

This document contains the report by the chairperson of the DBCP Task Team on Moored Buoys.

ACTION PROPOSED

The Panel will review the information contained in this report and comment and make decisions or recommendations as appropriate. See part A for the details of recommended actions.

Appendices: A. Report by the Task Team on Moored Buoys
B. Terms of Reference of the DBCP Task Team on Moored Buoys

-A- DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

6.3.1 The Panel noted the progress made on the new BUFR templates for moored and drifting buoys and that the WMO Inter Programme Expert Team on Data Reporting Maintenance and Monitoring (IPET-DRMM) had now approved these (with a few changes) for validation. This will involve (at least) two centres for each format in encoding and decoding the BUFR messages. The Panel encouraged those centres who issue data to GTS: e.g. Meteo-France and CLS-Argos for drifter data and NDBC, UKMO and Environment Canada for moored buoy data, to take part in the validation process, noting the deadline to cease using the old codes by November 2014.

6.3.2 The Panel noted that there was still no agreed NetCDF for submitting metadata to JCOMMOPS or a system at JCOMMOPS for making these metadata widely available. The Panel discussed the use of simpler formats (e.g. tagged pairs, csv, XML) as an alternative for submitting the metadata and encouraged operators to start submitting metadata to JCOMMOPS as soon as a format is agreed. Once these metadata were being received then DBCP-TC would develop a system for making them available via JCOMMOPS.

6.3.3 The Panel noted the various technical developments on moored buoy systems, reported both during the Technical Workshop and the National Reports.

6.3.5 The Panel thanked Mr Turton and members of the Task Team for their efforts in maintaining and improving their moored buoy networks and continuing to exchange their data, and for the inputs provided in its report. It was agreed that Mr Turton would continue as chairperson of the Task Team for the inter-sessional period.

6.3.6 **The meeting made the following recommendations**:

(i.) Rec1: for centres issuing moored buoy and drifting buoy data to GTS to start using the new templates (in parallel with the old alphanumeric WMO codes) as soon as possible.

(ii.) Rec2: for moored buoy operators to start submitting metadata to JCOMMOPS in either the agreed (Tagged Pairs or NetCDF) formats.

(iii.) Rec3: for DBCP-TC to develop a system for making the metadata available via the JCOMMOPS web site.

(iv.) Rec4:

(v.) Rec5:

6.3.7 **The meeting decided on the following action items**:

(i.) Action1 (**action; by; deadline**);

(ii.) Action2 (**action; by; deadline**);

(iii.) Action3 (**action; by; deadline**);

(iv.) Action4 (**action; by; deadline**);

(v.) Action5 (**action; by; deadline**).

-B- BACKGROUND INFORMATION *(if necessary, provide additional material to further explain the information in part A but that will not be included in the report of the meeting)*

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Appendices: 2

APPENDIX A

REPORT BY THE TASK TEAM ON MOORED BUOYS

This report details activities and progress made during the inter-sessional period since DBCP-28.

1. BUFR formats for buoy data

1.1 Regarding the WMO migration to table driven codes, at DBCP-28 the Panel reaffirmed that separate BUFR templates should be defined for drifting and moored buoys as the present (unvalidated) template for buoy data was not optimal for drifters or moored buoys. The TT-MB and TT-DM were tasked to finalize the proposed templates and submit them to CBS through the JCOMM Task Team on Table Driven Codes (TT-TDC).

1.2 The proposed templates were circulated for review by TT-MB and TT-DM in December 2012 and a few amendments were made. In May 2012 the updated templates were forwarded to the JCOMM TT-TDC for review and a number of further amendments were subsequently made, e.g. it was recommended that the template include a few basic metadata elements. Subsequently the templates were passed to the WMO Inter Programme Expert Team on Data Reporting Maintenance and Monitoring (IPET-DRMM) who met in early July with a recommendation to approve them for validation with a request that (subject to minimal changes being needed) they are fast-tracked for operational acceptance by May 2014. IPET-DRMM have suggested a few minor changes and the agreed templates should soon be published by them to start the validation process. While the templates allow for physical oceanographic measurements to be represented, there is likely to be a future requirement to include bio-geochemical variables.

2. Moored buoy metadata

2.1 At present there is little or no systematic collection of the relevant information (metadata) on the various moored buoy systems. Information is needed detailing the systems and what parameters they measure. Such information is needed by data users (e.g. who need to know heights (and depths) of measurements and whether corrections have been made) and their operators (who have an interest in the sensors and systems being used).

2.1 Over the last few years the metadata needing to be collected has been agreed by TT-MB and subsequently been published (http://www.jcommops.org/dbcp/data/metadata.html) on the DBCP web-site. At DBCP-27 it had been agreed the metadata should be submitted to JCOMMOPS in NetCDF for consistency with OceanSITES and tsunami buoys, and NDBC offered to lead on developing the SIF (standard input format) for the moored buoy metadata NetCDF. However, at DBCP-28 the Panel agreed that alternate formats other than NetCDF will probably have to be proposed to allow more flexibility for buoy operators to submit their metadata. Given, that the metadata may be more extensive for some moored buoy networks than others (e.g. some include sub-surface measurements) it is suggested that any metadata record for submission should be self-describing (e.g. NetCDF or tagged pairs).

2.2 A priority for this coming year has to be the setting up of a system at JCOMMOPS to receive and display the moored buoy metadata that are being (or will be) compiled by the various buoy operators.

3. Technical developments

3.1 Environment Canada Moored Buoy Network

3.1.1 Environment Canada (EC) continues to operate a network of ~50 moored buoys, with 23 buoys deployed on a seasonal basis (in-land lakes, or ocean areas affected by ice). All Environment Canada buoys continue to utilize the Watchman100 “payload” provided by AXYS Technologies Inc. Overall network availability has fallen to 82% for the last 6 months of 2012, and 83% for the first 6 months of 2013 following some system failures, as well as mooring failures on the Atlantic Coast. The main cause in the significant drop in data availability (historically near 90% or better) is a 40% year over-year decrease in ship-time provided by Canadian Coast Guard buoy tenders. There are three buoys on the Atlantic coast which have not been serviced for over 22 months.

3.1.2 The EC moored buoy network was temporarily expanded in the summer of 2012on the east coast of Canada with the deployment of 3 new seasonal moorings in the Gulf of St. Lawrence. Two 1.7 M WatchKeeper Buoys along with a TriAXYS wave buoy have been deployed in support of our Marine Weather Science Laboratory to help with the validation/verification of new coupled ocean atmosphere models. There is also a desire to validate the performance of wave model in shallow seas of the Gulf, with the results potentially improving predictions in northern waters such as the Beaufort Sea. In 2013, a new 1.7 M Watchkeeper buoy was deployed in Lake Ontario just south of Toronto, in support of the PanAM 2015 games. The buoy will report meteorological conditions every 15 minutes via cellular network, and wave data on hourly basis via Iridium satellite. The buoy is deployed in support of the sailing venue.

3.1.3 As reported last year, the main technical development or upgrade to the EC moored buoy network is the implementation of SatLink2 GOES transmitters provided by SUTRON. The SatLink2 provides a higher power (40W) transmitter, ensuring reliable data transmission at higher data rates (300 or 1200 bps) with the existing omni-directional antenna (Harsh 14A). Over 70 units have been procured to date and the entire EC network has not been retrofitted with the new transmitters. The performance of the new transmitters has been very good to date, however we continue to monitor potential problems related to using 300 bps transfer rate in rough sea conditions, as there is some evidence of increased parity errors, and loss of data. We continue to examine the data record, and where possible compare the performance of near-by buoys and ship reports to try and correlate increases in parity errors with sea state in excess of ~3 m.

3.1.4 EC has also continued dialogue with the National Data Buoy Centre Engineers in the hopes of increasing the reliability of the Harsh antennas, as these components have been identified as a weak point in our data communications. The antennas are prone to water intrusion, and are often the cause of missing, or intermittent data transfers. There are also instances when the fragile antenna is damaged when a buoy is deployed or retrieved. We have begun work to improve the water sealing (use of silicon to improve seal) and are also evaluating an upgraded version of the Harsh antenna that uses a stainless base. In addition to these efforts, Environment Canada Engineers are considering options to design and build an improved base or collar to hold the Harsh antenna in place, while not interfering with the transmitted signal. We hope to install a prototype into the network for testing by spring of 2014.

3.1.5 EC has continued to deploy and operate 2 Datawell MarkIII wave rider buoys in support of the PP-WET project. In addition to a direct comparison to the operational wave sensor on EC buoys (“strap-down” accelerometer), the moored buoy La Perouse Bank (3MD 46206) has been equipped with a TRIAXYS sensor (provided by AXYS Technologies). In the May of 2013, a GPS wave sensor from SCRIPPS was installed on a 3MD buoy at East Dellwood (46207), along with an AXYS TriAXYX directional sensor. All resulting data from the wave observation inter-comparison are delivered to CDIP for analysis as outlined in the PP-WET project plan, and also archived by DFO-ISDM.

3.1.6 An additional technological advancement which has been undertaken by the EC moored buoy network in the past year has seen the integration of an Iridium Short Burst Modem into the existing AXYS WatchMan100 “payload”. This has been achieved by adding a node of a WM500 processor within the Transmitter module of a standard EC buoy, with the WM500 in place to control the communications with the Iridium modem. Using bidirectional communications, it is possible to deliver commands to the primary WM100 payload via the WM500 (which is controlling the communications). This functionality will greatly enhance the amount of troubleshooting which can be done remotely, making it possible to reset power, reset the GOES transmitter, modify configurations, suppress sensors, change GOES ID etc. The Iridium SBD modem will also provide redundant communications for delivery of weather and wave data in the event of a failure to either the GOES transmitter or antenna. Four buoys in the North Pacific have been equipped with the new Iridium system in the spring of 2013. EC continues to assess their performance, and develop operational procedures for utilizing new functionality.

3.1.7 Finally EC is currently undertaking a competitive procurement process with the intention to replace the aging WM100 “payload” provided by AXYS Technologies. The WM100 is presently used in all moored buoy and AVOS (Automated Volunteer Observing Ship) installations. A Request for Information (RFI) was posted on the Canadian Government Tender System in early July 2012. An RFP (Request for Proposals, including pricing) will follow in late summer of 2013. The goal will be to procure a new system that can be easily integrated into the existing EC buoy hulls, and use both the existing suite of sensors as well as future measurement systems. This could include directional waves, current profilers, and potentially biological sensors to meet future requirements.

3.2 PMEL Tropical Moored Buoy Array

3.2.1 As of July 2013 the number of Indian Ocean RAMA sites implemented stands at 32 (70% complete). Two new sites were implemented between August 2012 and July 2013. Two additional sites are planned for the coming year, subject to availability of ship time.

3.2.2 A Southeast PIRATA Extension site in the tropical Atlantic which had not been occupied in several years was reestablished in 2013 and will be maintained annually.

3.2.3 Testing of PMEL’s T-Flex mooring system, intended to replace the legacy ATLAS moorings in tropical research arrays, is ongoing. The mooring system, which is essentially equivalent to ATLAS, uses more commercially available components and provides higher temporal resolution data in real time. Six prototype systems have been deployed for comparison with ATLAS systems. Replacement of some ATLAS systems in PIRATA and/or RAMA with T-Flex systems will begin in 2014.

3.2.4 CO_2 measurements are made on several TAO moorings by PMEL (http://www.pmel.noaa.gov/co2/moorings/) and on several PIRATA buoys by LOCEAN (http://www.lodyc.jussieu.fr/CO2tropiques/). O_2 measurements are made by the Leibniz Institute of Marine Sciences at the University of Kiel (IFM-GEOMAR). The University of Tasmania has provided fluorometers for deployments at two RAMA sites. . China’s Bai-Long mooring in RAMA has included CO_2 measurements since 2012. A CO_2 system supported by the Bay of Bengal Large Marine Ecosystem Project (BOBLME) will be deployed on a RAMA mooring in November 2013.

3.2.5 Oregon State University deployed dissipation measuring instruments (known as ChiPods) on 3 RAMA moorings in 2011. Additional ChiPod deployments are being planned or proposed on a number of RAMA or PIRATA moorings.

3.3 Other PMEL Mooring Projects

3.3.1 NOAA PMEL Ocean Climate Stations (OCS) are heavily instrumented moored buoys that contribute to the OceanSITES network of time series reference sites. PMEL OCS continues to operate two stations: the Kuroshio Extension Observatory (KEO), located in the recirculation gyre south of the Kuroshio Extension at 144.6°E, 32.2°N, and Station Papa, located in the eastern subarctic Pacific at 145°W, 50°N. The KEO site has been occupied since 2004 and the Papa site since 2007. Both moorings carry a suite of sensors to monitor air-sea exchanges of carbon dioxide, heat, and freshwater; wind; upper ocean temperature, salinity, and near-surface currents; ocean acidification; important aspects of the carbon cycle in the surface water; and bottom water temperature and salinity. The moorings are deployed with both ATLAS and Flex (similar to T-Flex) systems which provide duplication in most meteorological observations. The KEO mooring is maintained in partnership with JAMSTEC; Station Papa is maintained in partnership with the Canadian DFO Line P Program.

3.3.2 Most of the KEO and Station Papa data are available in near real-time through the project website: http://www.pmel.noaa.gov/OCS/. In addition, a subset of the meteorological data is available in near realtime through the GTS. Their WMO numbers contain the digits “84” identifying them as reference stations (KEO’s is 28401 and Papa’s is 48400). It is recommended that these GTS reference data should be withheld from all data assimilations so that they can be used as independent validation of the numerical products.

3.3.3 PMEL is contributing to the array of observations in Salinity Processes in the Upper Ocean Regional Study (SPURS). In addition to enhancing the number of sensors at a PIRATA mooring site, two PICO moorings are deployed within the SPURS area, providing temperature and salinity profiles from PMEL’s Prawler, a wave-powered subsea instrument that eliminates the need for multiple sensors on the mooring line.

3.4 Met Office moored buoy network

3.4.1 The Met Office moored buoy network presently includes seven operational deep ocean buoys to the west of the British Isles from the north of Scotland to Biscay (K7, K5, K4, K2, K1, Brittany and Gascogne). The two buoys in Biscay (Brittany and Gascogne) are operated in collaboration with Meteo-France. These buoys are funded through the Public Weather Service Programme, apart from K7 which is mainly funded by the offshore oil and gas industry. A further two buoys are operated off the coast of South Wales for the Milford Haven Port Authority (Turbot Bank) and QinetiQ (Aberporth). In addition two buoys are operated in collaboration with the National Oceanography Centre (NOCS) at the OceanSITES Porcupine Abyssal Plain (PAP) site and with Plymouth Marine Laboratory at E1 in the Western Channel. The data are presently reported to GTS in WMO FM-13 SHIP format.

3.4.2 The network buoys, which were designed during the early 1990s, are increasingly difficult to maintain as some of their components are ageing/obsolete (e.g. CR10x/PC42 electronics and Meteosat DCPs). All the operational open ocean buoys have dual sensors (other than the wave sensor), dual control electronics and dual satellite transmitters, with systems cross-linked for maximum resilience. Over the last five years they have been upgraded to use sonic anemometers and Iridium (in place of one of the DCPs). However, the intention is to replace them with new design systems over the coming years, where the Hydrosphere/Mobilis DB-8000 hull will be used for open ocean locations.

3.4.3 Wave measurements are normally made using a Datawell heave sensor, however on K5, K7, Brittany and Gascogne autonomous Triaxys spectral wave systems (which have their own Iridium transmission system) are also fitted and the data are presently being compared. The spectral wave data are reported to GTS in a short self-describing BUFR format. This will be superseded by the new moored buoy BUFR template

3.4.4 The K7 buoy was replaced end November 2012, with a new design system on a DB-8000 hull with dual met sensors, dual Axys Watchman 500s and dual Iridium transmission systems and has operated reliably since deployment (having reported significant wave height >15m and maximum max wave height >26m in February). The Turbot Bank buoy was replaced in March 2013 with a single Axys Watchman/Iridium based system and an autonomous Triaxys on a Planet Ocean DB300 hull.

3.4.5 The PAP buoy is a modified K-series buoy with a single Axys Watchman/Iridium based system with a standard OEM Triaxys for wave measurement. The other side of the buoy is given over to NOCS electronics to handle and transmit data from oceanographic sensors on the hull and from an instrument frame suspended 30m below the buoy. In December 2012 the buoy was damaged (collision) in high waves and recovered. A standard K-series buoy was provided as a temporary replacement until the buoy was repaired and redeployed in April 2013.

3.4.6 The new E1 buoy was deployed during June 2013. It is on a DB-8000 hull with a single met sensor system, Axys Watchman/Iridium and an autonomous Triaxys. The other side of the buoy (which also has an Axys Watchman/Iridium system) is used by PML to handle data from their oceanographic sensors. In addition the buoy has a winching system designed to lower/raise PML's sensors out of the water for cleaning. There is, as yet, no WMO sequence for distributing the bio-geochemical measurements from PML's sensors.

3.4.7 Comparison of the wave measurement data from the Triaxys and the Datawell Heave sensor is underway and initial results (for K5 at least) show good agreement. It is planned to deploy a Datawell MkII waverider adjacent to the K-series buoy at Aberporth to facilitate an intercomparison contributing to the Pilot Project on Wave Evaluation and Testing (PP-WET).

3.4.8 During the year much of the metadata (as defined on the DBCP web site at http://www.jcommops.org/dbcp/data/metadata.html) for the Met Office moored buoys has been compiled.

The Chair of the Task Team on Moored Buoys thanks members for their efforts in maintaining and improving their moored buoy networks and exchanging their data, and for the inputs provided for this report.

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APPENDIX B

TERM OF REFERENCE OF THE TASK TEAM ON MOORED BUOYS

(as adopted at DBCP-XXIV)

The DBCP Task Team on Moored Buoys shall:

1. Review and document operational moored buoy systems and their underlying requirements;

2. Liaise with the different communities deploying moorings, including TIP, OceanSITES, seabed observatories, as well as national moored buoy programmes (coastal and global), and promote the development of multi-disciplinary mooring systems;

3. Liaise with the GOOS Scientific Steering Committee (GSSC) and its technical sub-panel for Integrated Coastal Observations (PICO) to facilitate synergy between advances in GOOS implementation and the development of operational capabilities, in particular, for sustained coastal observations, analysis and related services by using mooring systems;

4. Liaise with the JCOMM Expert Team on Wind Waves and Storm Surges (ETWS) regarding the need for in situ wave observations;

5. Compile information on opportunities for the deployment and / or servicing of moored buoys;

6. Monitor technological developments for moored data buoys and liaise with the Task Team on Technological Developments on satellite data telecommunication aspects;

7. Review all relevant WMO and IOC Publications on Instrument Best Practices (e.g., JCOMM, CIMO) to make sure they are kept up to date, address WIGOS issues, and comply with Quality Management terminology;

8. Provide the DBCP Executive Board or the DBCP with technical advice needed for developing moored buoy programmes, including the issues above; and

9. Report to the DBCP Executive Board and the DBCP at its biennial Sessions, with periodically updated Workplans supporting implementation.

Membership:

Membership is open to all Panel members. Present members are as given below. The Chairperson is appointed by the Panel.

Mr Jon Turton, UK Met Office (TT Chairperson);
Mr Richard L. Crout, NOAA / NDBC
Dr Robert Jensen, USACE
Mr Chris Meinig, NOAA / PMEL
Mr Ariel Troisi, SHN
Mr Al Wallace, MSC
Dr Bill Burnett, NOAA / NDBC
Mr Paul Freitag, NOAA / PMEL
Mr Chris Marshall, Environment Canada
Dr Uwe Send, SIO
Mr R. Venkatesan, NIOT, India

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