# REPORTS BY THE TASK TEAMS

*(Submitted by the proposed Chairpersons of the Task Teams, and the Secretariats)*

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**Appendices**:

A. Report by the Task Team on Data Management;

B. Report by the Task Team on Instrument Best Practices and Drifter Technology Development;

C. Report by the Task Team on Moored Buoys; and

D. Report by the Task Team on Capacity Building.

# APPENDIX A

# REPORT BY THE TASK TEAM ON DATA MANAGEMENT

*(Submitted by Mayra Pazos)*

During the intersessional period, the TT-Data Management has promoted discussion between members, revised the proposed recommendations from last year to asses actions taken and proposed new recommendations.

**1.-** The TT-DM received reports from the Data Management Centers specializing in buoy data, ISDM (RNODC/DB), and Meteo-France SOC/DB. They are included in the Annex section.

**2.- Real Time Distribution of Data.**

2.1 AOML's Drifter Data Assembly Center (DAC) allocates WMO numbers for satellite tracked drifting buoys' data to be distributed on the GTS upon deployment. Sensor data are monitored by the Drifter DAC and taken off GTS as soon as bad data is detected or reports from the monitoring centers are received. Grounded drifters are also taken off GTS. During this period, the Drifter DAC insured that 998 drifters, with an average of one position fix every 1.2 hours, were placed on the GTS. The Drifter DAC consequently oversaw the distribution of more than 7.3 million quality-controlled observations on the GTS.

Korea requested that the Drifter DAC also create XML files and manage GTS distribution for drifters under their Argos program. WMO numbers for these drifters were requested with assistance from Etienne Charpentier. These drifters all had an offset of +4.55C added to their SST records to eliminate sensor bias.

A problem reporting battery voltage on the GTS templates was discovered. CLS fixed the templates to have battery voltage reported as both, sensor: voltage, in volts and HK_1 (House Keeping 1) in tenths of volts. This modification will affect only new drifters going on GTS, if existing drifters going on GTS are to be fixed, new XML files will have to be sent with both calibrations, and templates have will have to be reapplied to all drifters.

Recently, Pierre Blouch reported that 49 SVP drifters with GPS were reporting temperatures about ~2°C cooler than the models. Pierre, the DAC, CLS America, and the manufacturer collaborated to determine that the problem was in the accuracy of the a and b coefficients indicated in the XML files for the GTS (these coefficients had been truncated from the full accuracy provided by the manufacturer). DAC/AOML created new XML files with a, b coefficients with 5 decimal places, the calibrations were reapplied at CLS America and the drifters then reported accurate SST.

**2.2 Meteo-France** mainly focused their developments on a processing chain for Iridium SBD data during the past months. First, they defined a format family for the raw buoy data in the frame of the DBCP Iridium Pilot Project. Formats exist for simple SVP-Bs as well as SVP-BS (salinity) and SVP-BTC (with thermistor chain). Similar formats were defined for ship borne Automated Weather Stations (AWS) reporting through Iridium SBD or Inmarsat-C Data Report service. Then a chain producing GTS reports for these platforms was developed. FM13-SHIP and FM18-BUOY reports have been operationally transmitted onto the GTS for several months. To date, Meteo-France is processing Iridium data for about 100 drifting buoys and 10 AWS, for E-SURFMAR participants and a few other partners.

The chain is now producing FM94-BUFR messages (buoy and ship BUFR templates). However, the GTS distribution didn't start yet. As reported through the Iridium-PP report, Iridium SBD appears to be the most suitable communication system for drifting buoys and ship borne AWS: very cheap compared to Argos, very reliable, (The integrity of the transmission being managed by Iridium, the received data are exactly those sent by the platforms. No need to use redundancy, checksums, etc, the raw data are archived in parallel to the GTS data transmission), without any delays (immediate transmission), easy to handle (the raw data is sufficient).

**Meteo-France** reported they are also processing data from about 60 AWS reporting through Inmarsat but this is out of the scope of DBCP. This is to show that their view on data management is wider than a processing of Iridium data for drifters only.

A graph summarizing Meteo-France real-time and delayed mode data flow is shown in the Annex section.

**2.3** During this period, the **National Data Buoy Center (NDBC),** provided 24x7x365 data analysis and quality control support for 115 NDBC moored buoy platforms, 51 coastal marine stations, 200 water level stations, 39 deep-ocean tsunameters, 55 Tropical Ocean Atmospheric moored buoys in the equatorial Pacific, 40 oil and gas platforms in the Gulf of Mexico and 200 Integrated Ocean Observing Systems (IOOS) partner platforms (moored buoys and coastal stations). Through this effort, NDBC provided over 8 million quality controlled to the Global Telecommunications System (GTS) in real-time.

**NDBC** is working diligently to convert to the ARGOS 6-hour on/6-hour off reporting schedule. Currently 50 percent of the active weather buoy drift detectors have been converted, and all should be converted in FY2010.

**3. Delayed mode distribution and archiving of data**

**3.1** Regarding delayed mode distribution of data to the RNODC archiving center for drifting buoys, the Drifter Data Assembly Center **(DAC) at AOML**, submitted an update that includes drifter data from the period January 2006 through June 2007.
**ISDM** completed modifications to the processing systems required to handle new submission input formats and all data are now available for download from ISDM. **AOML/DAC** is preparing a 2008 submission that will be available for download soon.
**http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/drib-bder/svp-vcs/index-eng.asp**
The interpolated drifter data are available through March 2009 and can be downloaded from the AOML web site:
**http://www.aoml.noaa.gov/phod/dac/dacdata.html**

**3.2 Meteo-France** reports, that their purpose for handling delayed mode data is mainly for quality control. Every day, Meteo-France automatically collects the surface marine observations in the MeteoFrance GTS databank. In parallel, the model data at the position and time of the observations are collected. Comparisons are performed to issue blacklists and monthly statistics which are made available on the Web (see the **http://www.meteo.shom.fr/qctools/**). Plots of the data and of the differences with model outputs over the past 2 weeks are also displayed there.

Quality control procedures were improved at **Meteo-France** during the inter-session period: other models than this of Meteo-France are now used for comparisons; new parameters (humidity, sea surface salinity) are now considered; better interpolation methods are now applied to model data.

At **Meteo-France**, archived data are also used to produce weekly surface currents from drifters' positions. This doesn't replace AOML's products, but they satisfy centers such as Mercator who needs near real-time products. The files are sent to Coriolis. They only contain currents deduced from SVP drifters having their drogue attached (algorithm on submergence) and being well located (Iridium locations are not considered). In addition to current information, the files contain SST and SSS measured by the buoys if exist, plus the wind and the wind stress vectors provided by ECMWF interpolated at the buoy position.

**3.3 NDBC** published their latest edited edition of their quality control handbook, NDBC, 2009 Technical Document 09-01, Handbook of Automated Data Quality Control Checks and Procedures of the National Data Buoy Center.

**NDBC** reports the international CLIVAR/GOOS/JCOMM sponsors a coordination project called OceanSITES, a global network of ocean time series (or reference) sites located around the world's oceans. The NOAA/NDBC Integrated Ocean Observing System Data Assembly Center (IOOS DAC) and OceanSITES have agreed to make the NDBC IOOS DAC a Global DAC (GDAC), providing a shared and more secure capability together with the Ifremer/Coriolis GDAC in France. These GDACs will provide quality assurance/quality control, provide virtual access to the data, maintain a global time series dataset and synchronize catalogues on a periodic basis.

**3.4 The Technical Coordinator** (TC), Hester Viola, reported that The OceanSITES program has progressed on its data management and metadata sharing in recent months, which relates somewhat to DBCP members wanting to access moored buoy data and metadata. The data will be available, with full metadata descriptions, on the following Global Data Assembly Center sites: ftp://ftp.ifremer.fr/ifremer/oceansites/ & ftp://data.ndbc.noaa.gov/data/oceansites/. JCOMMOPS hosts a site catalog (Only a draft for now).

**4. Format Issues**

**4.1 NDBC** is concerned with the latest action item from CLS, sent in an e-mail from the Argos Users Group on 7/30/2009 "In order to have more ID numbers available for use with the Argos System, we must switch to a 6-digit ID number. Attached you will find a document that explains the switch to the 6-digit ID, including changes to data distribution and means of testing the new formats. The final implementation should take place in early 2010." This action will severely impact NDBC, and NDBC is exploring options at this time. AOML's Drifter DAC will also be impacted by this change. Software will have to be changed to handle the new format. This will take time and debugging, and will be done in a timely manner.

**4.2** There was a confusion regarding WMO ID numbers going to 7 digits. Etienne Charpentier, clarified that 7-digit WMO numbers can only be used with BUFR as BUOY reports do not accept them. This should be OK for drifters, but this issue should be addressed and the Panel should make a recommendation, (from DBCP-24 proposed recommendations). ISDM reports that the RNODC processing and archival systems will be able to manage 7 digit WMO numbers.

**4.3** There is a concern that there is still a lack of standardization in Argos data formats that is creating at times excessive work to decode the data. It is recognized that in some cases new formats are required to suit particular needs of some users, there might be other cases where new formats may not be necessary. It is encouraged that manufacturers try first to see if an existing standard format would meet the user's requirements before a new format is designed. In the case where additional data is needed in the message, it would be most desirable that the message has the "standard" data in the front portion of the message and the user-specific data behind that.

**5.** Based on discussions and decisions made at the META-T Steering Team meeting in Geneva, Switzerland on 16/17 September 2008 – NDBC and the National Marine Data and Information Service (NMDIS, China) will develop and maintain two mirror servers for the META-T project. META-T is aimed at providing an international standardization framework for collecting Sea Surface Temperature 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).
The action is to obtain "real-time" water temperature metadata and begin providing the information via national servers in China and the U.S. The metadata is characterized in three ways:

1. Category 1 metadata distributed in real-time with the observational report. Category 1.a metadata is metadata information distributed directly by the ocean platform, while Category 1.b metadata is not transmitted by the platform but appended onto the observation report by a data management center.
2. Category 2 metadata is metadata that is required in real-time but not distributed with the observation.

3. Category 3 metadata is something – but no one seems to know exactly what it is, and no one talked about this type of metadata. Guess there was a needed to have three categories, just in case.

**6.** The **Technical Coordinator (TC)** reports that an update of the DBCP Technical Document 3 will be finalized in time for the DBCP meeting, this includes new/updated descriptions of the elements of the Argos System and some information about its data management practices.

**7. Development of the WIGOS Pilot Project for JCOMM**

The **TC** informed the Team that there is a (fairly) recent progress report of the WIGOS Pilot Project for JCOMM available here:
**http://www.jcomm.info/index.php?option=com_oe&task=viewDocumentRecord&docID=3559**It does relate to the Ship Observations Team, but should still give some good background information.

**8. Actions from last year's proposed recommendations**

**8.1 TC** reported that CLS is currently extending its Delay and Timeliness Monitoring Tool to include analyses over ocean basin areas of interest (as defined by the DBCP TC).

**8.2** There has been a good response by buoy operators to the Iridium Pilot Project, however it would be good f or all data archiving centers to check and see that they are receiving all GTS data and can access delayed mod e data from all buoys in the project (which are not being processed by CLS). A list of all active and inactive b uoys can be found in:

**http://www.jcommops.org/dbcp/iridium-pp/deployments/buoys_iridium.csv** (**Action**: **Data Centres and Iridium PP participants**).

**8.3** BUFR Template

**8.3.1 ISDM** raised the question about the impact of wave sensor data and the requirements to handle and format spectra information. Should the Drifter Template be expanded to include full Wave Spectral data or will it be encoded into separate Waveob BUFR messages. ISDM would prefer to keep it all together in the same message but if a mechanism to match up different messages from the same instruments is in place, it should not matter too much. ISDM already manages wave data for Canada and would probably be able to manage it under the RNODC as well but there may be other alternatives. The Team is asking for a recommendation.

**Meteo-France** reports that the BUFR template for buoy data already includes wave spectra data. The Spanish are reporting such data for their moored buoys, they don't report in BUOY + WAVEOB. The processing has been fully operational for several months.

**NDBC** is not providing wave data at this time. The plan is to provide tsunameter data via BUFR within the next year.

**9. Review of roles of archiving centers**

**9.1 ISDM** reports that progress has been made towards this action item. A community white paper (CWP) on the Data Management System for Surface Drifters has been prepared and submitted by Bob Keeley, Bruce Bradshaw, (ISDM) and Mayra Pazos (AOML) to OceanOBS09. Unfortunately, SOC (Meteo-France) was not able to contribute to this paper. This and similar documentation from SOC will be used as the basis of further discussions for identification of potential overlaps and opportunities for improved data management. A copy of this CWP is included in the Annex.

**9.2** A report of SOC general activities is included in the Annex.

The chair of the Task Team on Data Management would like to thank all who participated in the discussions and provided inputs to this report.

## ANNEX

## Data Management System for Surface Drifters

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Summary

The large scale deployment of surface drifters has its origins in the FGGE programme in the late 1970s. Over the course of the next 25 years, surface drifters have become routinely used in all oceans so that now there are more than 1250 operating. The data management systems to handle the data returned from these platforms started with FGGE and have evolved. The main difference between the early years and now from a data system perspective is the volume and timeliness of reporting the data, though more variables are also being measured. Presently there are more than 1 million records reported in real-time and such high volumes are straining processing systems that were originally set up for fewer records and manual scrutiny of the data. The future system will need more sophisticated algorithms for automatic detection of possible errors and these must be developed in cooperation with the scientific and instrument communities. Data must move more quickly through the processing streams and become available to users. Despite the large volumes, there is high demand for on-line access to the entire archive. Strategies must be developed to meet this demand without large data requests swamping data servers. Part of this will involve providing data browse and selection tools that permit a user to refine their request to only the data of interest. Finally, there is an increasing need to use data from different sources to examine a variety of scientific and societal problems. Standard vocabularies for naming variables, instruments, methods, etc., must become widely used to allow easier interoperability of data.

1. Introduction

The surface drifter program began during the First GARP (Global Atmospheric Research Programme) Global Experiment (FGGE) and in earnest in the late 1970s. The data from these instruments are used to support short-term (seasonal to inter-annual) climate predictions, climate research, ocean monitoring, calibration of satellite SST, barometric observations for improved weather forecasting, observations of ocean-atmosphere interaction during hurricane passage and for educational and outreach efforts. Prior to the start of this programme there was no data management system for the data from drifters. Shortly after FGGE, the drifting Buoy Technical Coordinator was created and Canada became involved handling the data. In mid 1985, Canada (formerly MEDS but recently renamed to Integrated Science Data Management, ISDM) applied to the International Oceanographic Data and information Exchange (IODE) committee of the Intergovernmental Oceanographic Commission (IOC) and was accepted to be the Responsible National Oceanographic Data Centre (RNODC) for surface drifter data. As an RNODC, ISDM agrees to manage the international archive of all surface drifter data. This includes any data reported in real-time and whatever data are submitted to them in delayed mode. During the World Ocean Circulation Experiment (WOCE) a Surface Velocity Programme Data Assembly Center (SVP-DAC) was identified as needed and Canada combined operational data management activities with the Atlantic Oceanographic and Meteorological Laboratory (AOML) in Miami, U.S.A. AOML formed the Global Drifter Program’s Drifter Data Assembly Center (DDAC) to apply delayed mode quality control (QC) to the surface drifter data. Canada continued to receive and archive the real-time data and acts as the long term archive for the delayed mode data. The Drifting Buoy Cooperation Panel (DBCP) was created and later became a part of the Joint Commission on Oceanography and Marine Meteorology (JCOMM) when JCOMM was formed in 2001. With the end of WOCE, cooperation between Canada and AOML has continued although updates do not arrive as often as occurred during WOCE, due in most part to the increase in data volume.

2. General Organization of Activities

The management of the surface drifter data stream is relatively simple. The largest fraction of surface drifter data circulates on the Global Telecommunications System (GTS), the system operated by the World Meteorological Organization (WMO) for broadcasting meteorological and oceanographic data to meteorological centres around the world. This distribution system has been promoted by the DBCP as a way to ensure widespread distribution of the observations. In recent years, some countries have provided internet access, in addition to distribution on the GTS, to the data collected by the buoys they operate. The ISDM role is to capture all of the data from the GTS to ensure a complete (global) and long term archive of the data and provide dissemination to users.

The Global Climate Observing System (GCOS) objectives laid out in 1992 and recently updated placed a target of 1250 buoys, uniformly distributed in the world's ocean. The target number of buoys was reached in 2005, but there are still challenges to achieve the global coverage.

Most drifters reporting data on the GTS use the Argos system, although Iridium satellites have gained popularity in recent years. There is also the facility of Local User Terminals (LUTs) to download data from the satellite transponders used by Argos. These LUTs sometimes also report data onto the GTS but their reported buoy positions tend to be less accurate than those from the Argos system because they usually lack the most recent satellite ephemeris data. However, they sometimes report data more quickly.

3. Data Formats and Volumes

The GTS has strict rules for the format of data. Originally data were reported in character code forms. These have evolved over the years to what is currently the BUOY code form. A number of years ago, a binary form for data reporting was designed for surface drifter data. This uses the generalized BUFR data structure with a template used to simplify encoding and decoding. Now all surface drifter data are reported in both BUFR and BUOY code forms. Reporting in BUOY will cease sometime in the 2011 time frame.

Consistent formatting ensures that material is presented well and makes the issue of software maintenance relatively simple. The main complication has been in the changing content with the changes in the character and now binary forms used to report the data.

Surface drifter data, especially sea surface temperature and increasingly surface air pressure data are used by meteorological models for numerical weather prediction. These models have strict time windows to accept data and so the requirement is to place drifter measurements on the GTS as soon as received. Because of the characteristics of the Argos system, buoys can report partial or complete messages multiple times on a satellite pass. As well, because the surface location of the buoy is computed from the Doppler signal of the transmission, the quality of the position depends on the relative positions of satellite to surface drifter and signal strength. This results sometimes in small differences in reported positions from one message to another. What appears on the GTS is that in the space of a few minutes, there can be multiple messages from the same buoy, with content differing in the separate messages. That is, the positions may be different, the observed values may be different, and the suite of reported variables may be different or the same between messages.

It is an easy matter to capture all of these multiple messages. As an ocean archive centre, Canada seeks to assemble the data, remove redundancies, apply consistent quality control procedures and distribute the best version possible of the data. Removing the redundancies is particularly important since users in delayed mode do not usually want to see all of the duplications. Real-time users simply consolidate all of the observations and allow models to use the assimilation scheme to sort out the differences.

The number of messages being received has been steadily increasing even after the target number of buoys has been reached. The volume of data now received is well over one million messages each month. ISDM processing collapses the number of reports where locations and times are the same, but different messages have different content. The experience is that this reduces the number of messages by nearly a third. Figure 1 shows the growth in the size of the archive both in the number of archived messages and the number of bytes of information.

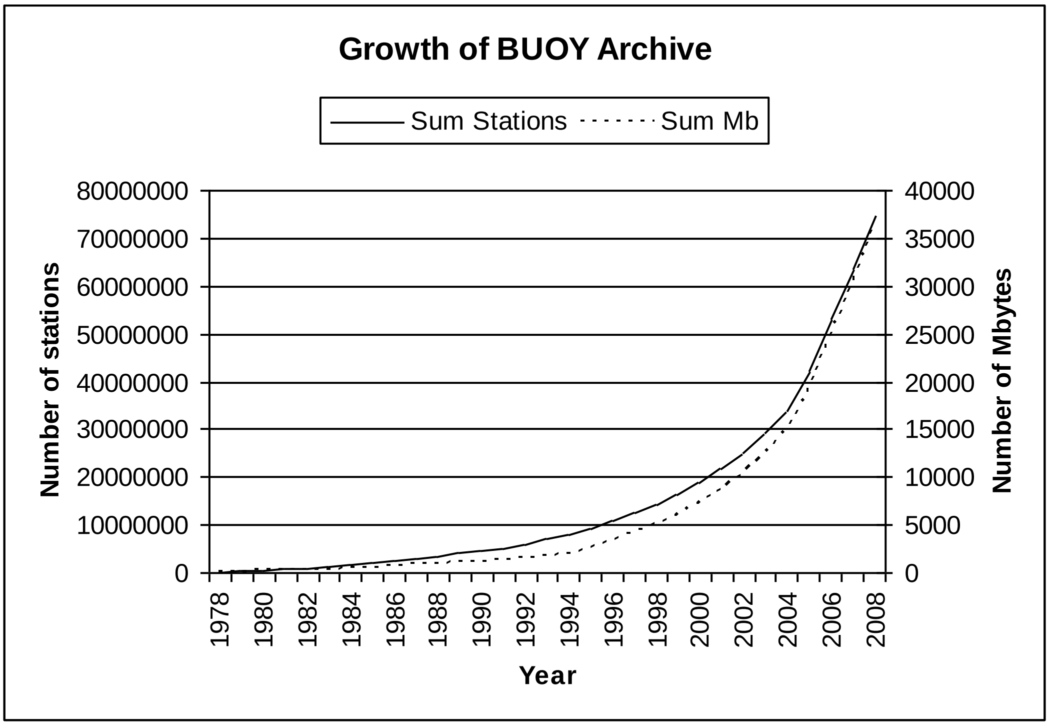



Figure 1: Growth of the real-time data archives.

4. Operations at ISDM

ISDM currently uses the data reported in BUOY code as the basis of its archives. We have software for managing the data coming in BUFR form, but this is not yet in production. The BUOY code form has evolved over the years and this has caused significant work to reprocess the archives to change the way data are stored. The major change took place when the message content was changed to allow for transmission of the time of the position determination separately from the time of observations. Because of choices made in how to archive this information, and concerns expressed by DBCP, ISDM was required to reprocess a significant fraction of the archive. In the end this meant reprocessing many millions of records.

In 1985 ISDM became a designated RNODC for surface drifters. This was based on experience gained during FGGE and the establishment of capabilities to manage data coming from this platform. One of its first actions was to ensure that it had data in its archives from the end of the FGGE program until 1985. This required the recovery of many thousands of records from the real-time data stream from the start of 1980 until the end of 1985 and was done with the assistance of the US National Climate Data Center and the managers of the International Comprehensive Ocean-Atmosphere Data Set (ICOADS). All of these data were processed through the existing system.

The ISDM system has evolved but still relies on the GTS as the primary data source. ISDM is not directly connected to the GTS because it does not operate within the national meteorological services of Canada. Instead an arrangement with the appropriate government agency copies the BUOY messages from the GTS data stream and sends by ftp a file of retrieved data every 15 minutes to an ISDM server. These files are accumulated and once a day the content is processed through software that decodes the BUOY code form and transforms the data into the ISDM internal format. Messages that cannot be decoded are placed in a separate file in the same format as received. Each working day, the contents of this file are reviewed to recover whatever can be used. Sometimes this means removing parts of a message that failed the decoding process.

The daily files of decoded data accumulate over the course of a month before further processing. This procedure was adopted because there was no evident need for a more rapid turn around in data. Times have changed and ISDM has received requests for more rapid data dissemination. These and other factors (increasing volumes of data and needing to change system software) will likely cause a speed up of processing.

The initial step in monthly processing is to split off a calendar month of data from the accumulating data file. All subsequent processing is on this calendar month. The split actually occurs a few days after the end of a month. Data proceeding the target month are removed from the file; the number of records lost this way is very low. Data from the most recent month are returned to the accumulating file.

The monthly file is processed to remove the duplications and near duplications described earlier. Messages from the same buoy are sorted by time of observation. Groups of messages received during the same satellite pass are identified by the small time differences between them. Messages that have identical times and locations are then examined to identify identical observed values or where different messages have different observed values. Where possible, multiple messages are then collapsed into a single message at the given observed time and location.

Data received from LUTs are also considered. Messages received from LUTs are associated with the same messages from Argos system. This is done by matching buoy identifier and observation time. Position is not used since positions provided by LUTs are often less reliable than those from Argos. Messages received from LUTs that are identical in content and time are deleted from further processing.

The monthly file after processing is then passed to a quality control procedure. This is a mix of automated and manual scrutiny using a graphical application. Buoy tracks are constructed from the times of position and locations. Time series of air pressure and surface temperature are displayed. Other variables are also displayed if present in the GTS message. Drift speeds are calculated from consecutive buoy positions and times. Where these speeds exceed 5 m/s, the position is marked with a quality flag that indicates it is suspicious. Positions are marked rather than times because the position is calculated from a Doppler measurement whereas time is taken from a clock. The suspect positions are removed from the display, but retained in the data file.

Observed data pass through a simple range check of the value. The technician views the graphical displays and looks for spikes in the observed values. Where these occur he can set a quality flag to express his degree of doubt. He proceeds to examine these monthly time series until he is satisfied that the data portrayed look reasonable.

On completion of the quality control, the data are added to the ISDM archives. All observed values that pass through initial duplicates processing are retained in the archive regardless of the quality flag. All observed values as well as times and positions are assigned quality flags. In addition, a history of the processing steps through which the records passed is retained as well as any changes that might have been made in the data. If such changes occur, the changed value is marked by a special quality flag, but the original value is retained in the processing history record.

## 5. Data Serving

The ISDM archives contain many millions of records (a position and time plus observed values constitute one record) as indicated in figure 1. On-line displays of the last 30 days of data are shown on the ISDM web site (http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/drib-bder/gts-smt/index-eng.asp ). Because of the data volume and server capabilities, the data are not placed on-line for user self serving. It is our experience that some data requests are very large (e.g. all data from the Pacific Ocean) and if the data were placed on-line we would either need to subdivide the request into many files or the server would be overtaxed. Instead users wanting data can request them through an on-line form which generates an email for ISDM staff to respond to. Nevertheless, it is clear that improvements are needed for more automated access to our archives.

6. SVP Data

AOML OPERATIONS

AOML operates the Drifter Data Assembly Center as part of the Global Drifter Program. Raw data are received daily and monthly from Argos for AOML programs, and also for programs belonging to other national and international partners. These data are quality controlled and interpolated in delayed mode at about 3 month intervals. Details of the quality control and interpolation procedures carried out at AOML can be found in Hansen and Poulain (1996) (http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/drib-bder/svp-vcs/res/qc-cq-eng.htm ). AOML makes the interpolated, quality controlled data available through a web interface, but there is no web access to the raw or quality controlled non interpolated data. . These data are offered to researchers, operators and users in general when requested via e-mail; AOML has not been funded to provide data distribution. ISDM operates in partnership with AOML in maintaining the SVP archive and its continuation after WOCE. Data are received from AOML usually about once a year in a number of separate files containing different levels of processing. A Directory file contains one line per buoy with metadata information. A Raw file containing each buoy identifier with the raw data. A "P" file contains a list of buoy identifier, position times and location. An "S" file contains a list of buoy identifier, sensor time and data from different sensors. A “K” file indicates buoy identifier, and contains uniformly interpolated data to 6 hour intervals, including velocity, speed and error estimates from the measured values.

“P” and “S” files have been quality controlled with bad positions and SSTs discarded. “S” files have more records than their counterpart “P” files because there are more sensor data transmitted per satellite pass than there are positions. ISDM recombines the P and S files into a single file using position times to link to the closest sensor times from the S files.

Other processing is also required to reconcile differences in how AOML and ISDM archive data. The data then are placed in an archive separate from the data received from the GTS. The size of this archive is shown in figure 2.

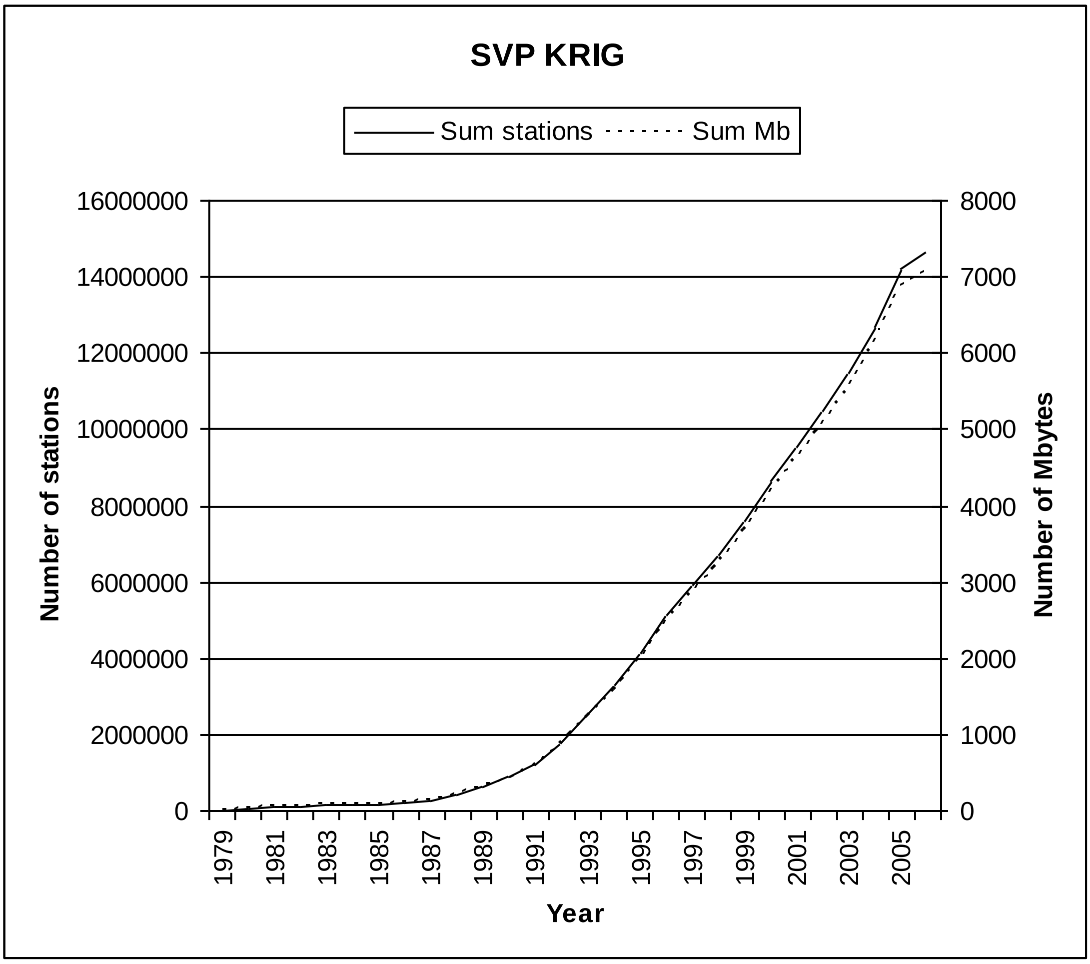



Figure 2: Growth and size of the SVP Archive

At the same time, files (in ASCII form) from all different processing levels are built by year and ocean basin from the data just received and these are placed on the ISDM web site (http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/drib-bder/svp-vcs/index-eng.asp . These may be downloaded as needed.

7. Data Dissemination and Users

While the main objective at the start of the data system for surface drifters was to protect the data from loss, access to the data has also been supported. At present, users can access web pages at both ISDM (http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/drib-bder/index-eng.htm) and AOML (http://www.aoml.noaa.gov/phod/dac/gdp.html) where products and data are available. At ISDM about 8 GB of data were downloaded by 8,000 visitors in the past 6 months, with 60% from outside of Canada. In addition many of the visualization pages, even those that are static monthly maps, are routinely accessed as well. Each month all of the data captured by ISDM are routinely uploaded to two international organizations.

Users are scientific and operational although most operational users get the data directly from the GTS if they require the data quickly. Scientific users range from those wanting data from a small area or time frame, to others who want data from large areas and long time frames (significant fractions of the entire archive). Typically, ISDM handles through manual means about 2 requests a month for surface drifter data.

8. Lessons Learned and Challenges

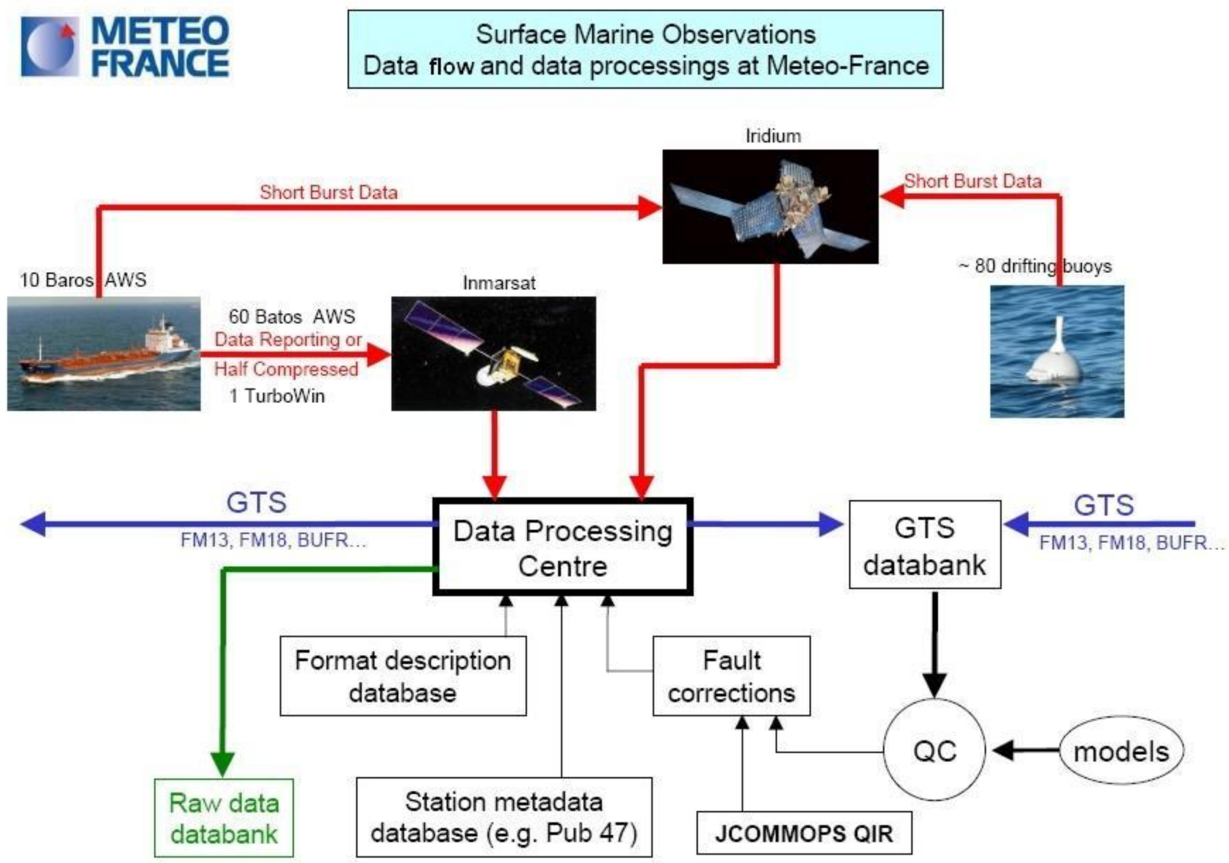
A number of observations can be made about the data handling of surface drifter data and some comments made about the future.

- Recording the processing history, any original values, and all data but with quality flags has been very helpful. The processing history allowed us to identify more precisely where problems have occurred even many years after the data were processed. By preserving all data but with quality flags, ISDM has been able to carry out reprocessing of the archives as changes in code forms and mistakes were found. If data assessed as bad or suspicious had been removed, it would have been necessary to go back to original records as received which would have made the reprocessing a much more time consuming process.
- ISDM chose a data structure that used indirect referencing for reported data and information. In simple terms, a code is associated with a value. The code indicates what is being stored and the value provides its content. We have used this to store both observations, using for example TEMP to indicate water temperature followed by the observed value, and information, such as IST$ to indicate the instrument used followed by its name. By doing so, we are able to adjust to the changing content reported in GTS messages by simply adding new codes for new information. Without this flexibility, we would have needed to change archive structures and even processing software many times over the years.
- Having achieved the GCOS target of 1250 buoys likely means that the growth in data volumes will ease somewhat. However, the goal of uniform buoy density in the oceans has not been achieved and will require more drifters than the 1250 target figure. Such data volumes are straining existing processing procedures and these procedures will require changes.
- Changes in processing are also required to provide a faster delivery of fully processed, quality controlled data. This will mean more complete processing more rapidly than on a monthly basis and so changes in how the QC is accomplished. Presently it takes nearly the same amount of time to process one full month of data from a buoy as would be required if we did one week or one day This is because we view data buoy by buoy and the number of buoys is independent of the number of days of data. It is likely that we will need to carry out a more automated version of QC for quick data delivery.
- Accepting and processing data encoded in BUFR will change the content we must process and may allow other tests to be conducted on the data. This will mean software changes as well.
- Working with AOML in the context of the WOCE and afterwards has been a very good experience for ISDM. It provides contact with scientists working closely with the data and this is always a good thing for a data centre to do. In retrospect, it would have been better to coordinate our two processing systems. As it stands, the differences between the two cause a significant amount of processing at ISDM.
- Close contact with the observing programme, through the DBCP are also very important to a data centre. These contacts provide links to the programmes placing buoys in the water, to Service Argos and the processing that occurs there and helps us to understand why data are reported the way they are and so allows us to adjust our processing to exploit or compensate for what happens. Again, close contacts between the data archive centre and the deployment program have been very beneficial.

Looking forward, the following will be objectives for improving management of the data.

- Despite the data volumes, on-line access to raw, edited and fully quality controlled data needs to be made. Such access needs to provide data selection tools to allow users to fully refine the quantity of data desired.
- Closer cooperation with the scientific community will be needed to develop and prove more robust QC systems as a necessary condition to dealing with increasing data volumes.
- To support fully accessible archives there will be a need to visualize at least the times and locations of the available or selected data. Visualization of the content of the potential data set (i.e. what variables are present and to what degree on each buoy) is also highly desirable.
- More than one data access and visualization system will be needed. Just as the clientele of an archive are varied, so are their needs for such access. Use of web services will assist to meet some of these demands.
- Because surface drifters will continue to be used for sensors more and different from the current suite, any data system will need to be agile in adjusting to the new variables. Such ability currently exists, but as systems migrate to more modern software, this ability needs to be retained.
- It is important for the surface drifter data systems to collaborate and conform to internationally accepted vocabularies for variables, instruments and other information. This will permit easy and reliable comparisons of the same variable from different platforms. The data system will need to incorporate these vocabularies as they are developed.

A number of the challenges and changes noted above are being addresses already. We have adapted some quality control procedures to become more automated. However, collaboration with a scientific organization to explore other strategies will be helpful. Software has been developed already and is in final testing for dealing with data served on the GTS in the BUFR format. We are in the process of verifying that all information transmitted in traditional character codes is also coming in BUFR before we make the switch over to dealing in BUFR only. ISDM has and will continue to support a staff member to attend DBCP meetings. Software to improve visualization of the archives currently exists. The main hurdle is to allow such visualization for a large archive without significantly degrading server response times.



## APPENDIX B

## REPORT BY THE TASK TEAM ON INSTRUMENT BEST PRACTICES AND DRIFTER TECHNOLOGY DEVELOPMENT

*(Submitted by Dr. William Burnett, Chair of the Task Team)*

During the intersessional period, the DBCP drifters performed well, in general.

The Task Team would like to make reference to the proposal by the WMO Integrated Global Observing System (WIGOS) Pilot Project for JCOMM to agree on a strategy for updating the WMO and IOC Technical Regulations. This Task Team will be expected to commit some time and effort to support this activity, especially in observing Sea Surface Temperatures (SST) – and to support DBCP's request for resources to employ a consultant to support the activity. Further discussions on this topic will occur during the meeting under agenda item 11.5.

### Global Drifter Program/Data Assembly Center Evaluation

The Global Drifter Program/Data Assembly Center continues to evaluate drifter's transmitter and drogue's life. During this intersessional period they reported that in 2008 ***Technocean*** made an adjustment/improvement to their submergence sensor that lead to a much clearer signal that helped in the interpretation of drogue lost. Their drifters with strain gauge sensors also had a clear signal of drogue lost, but in either case the number of drogued days did not improve. ***Pacific Gyre*** drifters with submergence sensors continue to be pegged at the highest possible values for a long period of time, indicating exceptional drogue life time or some sort of malfunctioning of the submergence sensor. ***Pacific Gyre*** drifters carrying strain gauge drogue sensor deployed as part of the Bay of Biscay study last year all failed to report drogue values, no other strain gauge drifters have been made by ***Pacific Gyre***. ***Metocean*** submergence sensors have always given clear drogue off signals, they also manufactured drifters with strain gauge sensors that were recently deployed in July 2009. ***Clearwater*** has been using strain gauge sensors for several years, the signal indicator of drogue off is very clear although the number of days drogue stays on still needs improvement.

***Pacific Gyre*** is making a new wind drifter that measures wind with acoustic anemometer on the surface float rather than using a subsurface hydrophone. These new wind drifter design are expected to be tested during the 2009 hurricane season.

### MetService NZ Evaluation

During the southern summer (2008/2009) MetService New Zealand deployed 40 SVPB buoys into the Southern Ocean to the south and east of NZ under the Southern Ocean Buoy Programme (SOBP). The buoys were all manufactured by ***Technocean***, 30 were GDC Buoys and 10 were NOAA buoys upgraded by MetService NZ.

The performance of these 40 buoys was marred by some early drogue failures and intermittent spikey air pressure data. Of the 40 buoys deployed in the period August 2008 to February 2009, thirteen drogues were lost in the first 90 days. The pressure data from 8 buoys was removed from GTS due to spikey and erratic data, 7 within the first six months and another at 9 months.
The problem of spikey buoy pressure was raised with ***Technocean*** and members of the TT IBPDTD, and individual buoys showing spikey pressure in December and January were compared with wave data to see if there was any correlation between air pressure spiking and significant sea state. In this period, no relationship between spikes and waves could be seen, and this led to discussions about whether buoys without drogues were submerged more often, thus not allowing barometer breathing to occur.

In March 2009, three buoys within close proximity of each other showed an odd diurnal signal where pressure spiking occurred in a synchronized manner at about local noon. The reason for this effect was discussed and solar heating was discounted as a possible cause. All three buoys had lost their drogues.

MetService NZ would welcome a review of the air pressure de-spiking algorithm. It was hoped that the DBCP-M2-TEST format, as used on some buoys, might offer clues to how the de-spiking algorithm could be improved. The on-board processing capability of buoys is now such that a new sampling regime and algorithm could be performed.

**Centre of Marine Meteorology of Météo-France Evaluation**

Iridium drifters
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The Centre of Marine Meteorology of Météo-France focused mainly on its technical activities evaluating the Iridium Short Burst Data (SBD) transmission as an alternative to Argos for operational purposes. The work, which concerns SVP-B drifters as well as other platforms, is partly seen as a contribution to the DBCP Drifter Iridium Pilot Project.

SVP-B prototypes from three manufacturers – all fitted with a GPS – were first evaluated by Météo-France. Then, several batches of SVP-Bs, without GPS were ordered for E-SURFMAR – 125 buoys in all. Out of them, about one hundred were deployed and more than sixty were in operation by mid-July 2009.

Globally, these buoys have provided excellent results for availability and timeliness. The number of reports received from E-SURFMAR drifting buoys within 50 minutes increased significantly and their quality appeared the same than those Argos buoys. The amount of buoys which ceased to work after emptying their batteries is now sufficiently high to measure mean lifetimes. A complete report on the evaluation of Iridium drifting buoys will be presented at the Technical and Scientific Workshop.

To satisfy both oceanographic and meteorological needs the new Iridium SVP-Bs ordered from 2009 were fitted again with GPS. GPS positions will be first received every three hours.

Three Iridium SVP-Bs built by ***Technocean*** will be soon tested by Météo-France.

The raw Iridium data of all these buoys, plus a few ones from other organizations, are received and processed at Météo-France. They are coded into FM18-BUOY and FM94-BUFR messages and sent onto the GTS a few minutes after the observation.

Ice drifters reporting Air Pressure
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In the frame of the International Polar Year, different kind of drifters reporting air pressure at the sea surface were deployed in the Arctic Ocean through EUCOS/E-SURFMAR funding. Fourteen buoys were deployed: two IcexAir from CMR (air deployed in 2006), two Iridium SVP-B, two standard Argos SVP-B and three ICEB buoys from ***Metocean*** (in 2007), five Argos SVP-B from ***Metocean*** in 2008. Four additional buoys will be soon deployed. IcexAir and ICEB buoys report the air temperature in addition of Air Pressure. ESURFMAR will try to continue to deploy drifting buoy in the Arctic Ocean.

SVP-BS (salinity) and SVP-BTC (temperatures in depth)
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The evaluation of SVP-BS buoys from ***Metocean*** and ***Pacific Gyre*** continues. These evaluations will be particularly useful during calibration and validation of the SMOS (Soil Moisture and Ocean Salinity) satellite which should fly in 2010. The first SVP-BS transmitting through Iridium was deployed in the Gulf of Biscay in May 2009. Unfortunately it stopped transmitting at the end of June. The buoy, developed by ***Metocean***, was recovered at sea.

Météo-France also continues to evaluate SVP-BTC drifters from ***Marlin Yug***. Eight buoys were deployed in the North Atlantic since 2005. The last buoy deployed in mid-June 2008, with a new version of the thermistor string ( 80 metres long), has been in operation for eleven months in the Atlantic Ocean. ***Marlin Yug*** deployed three Iridium SVP-BTC in the Black Sea by August 2009. The data are sent onto the GTS by Météo-France.

***Marisonde*** GT (wind and temperatures in depth)
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FGGE type drifting buoys, fitted with a thermistor chain, have been used for several years to contribute to the study of sea-air interactions. The ***Marisonde*** buoys measure the wind, atmospheric pressure and sea temperature at various levels. The ARGOS system is used for location and data transmission. New generation of ***Marisonde*** buoys are under construction. The bathythermic string is 300 meters long, includes 16 temperature sensors and 4 hydrostatic pressure sensors on two separate « bus ».

Stain gauge test
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Meteo-France deployed 15 SVP-B for Global Drifter Center (GDC) of NOAA/AOML in Biscay Bay by August 2008, fitted with strain gauge on the anchor, in 5 clusters of 3 buoys, for evaluation. Three out of them were recovered at sea (2 ***Technocean*** and 1 ***Pacific Gyre***) and sent back to AOML by May 2009.

**Environmental Canada Evaluation**

Environment Canada continues to deploy Iridium drifters manufactured by ***MetOcean*** (all equipped with GPS). Seven Iridium buoys will be deployed later this year in the Northeast Pacific, however we have faced challenges finding ships of opportunity or other options allowing for deployment north and west of traditional shipping routes. Experience to date with 2 Iridium drifters suggest improved timeliness of observations and reduced costs when compared to ARGOS drifters in the same area.

Environment Canada is working with ***JouBeh Technologies Inc***. and ***Scotia Weather Inc***. to facilitate GTS routing of drifting buoys operated by commercial companies in Atlantic Canada. The Oil and Gas industry deploys a small number of SVP type buoys each year to support their
operations (not certain if they have barometers). The new arrangement will allow data received from new Iridium drifters operated by commercial firms to be routed to the GTS, in time increasing data available to users in the Northwest Atlantic.

**Marlin Yug Comments**

Their evaluation of first prototype of Iridium-GPS SVP-B mini drifter in the South Atlantics has showed that the buoy has good quality of AP measurements under any environmental conditions for full-lifetime. Since 2008 all the drifters were provided with Real Time Clock (RTC) on basis of GPS synchronization or factory installed watch for drifters without GPS. GPS synchronization allowed them to establish high accuracy GMT time for the buoy. RTC can be used for different goals, e.g. for samples at round hours. On-board data processing has been updated to optimize buoy interaction with Iridium link, with the goal to have shorter durations of SBD sessions and have, at the same time, more attempts for SBD sessions, to increase buoy's lifetime and to eliminate doubled hourly samples sent via Iridium.

Iridium modem and GPS receiver antennas have been replaced to the top of surface float, as close as possible, to have better radio visibility between buoy and satellite systems in different weather conditions. Those transferences were carried out to have smaller probability of most fresh GPS fixes gaps as well as to decrease Iridium transmission duration. The buoy's software was updated to avoid the GPS data gaps, when bad weather conditions, transmitting fresh of old fixes in each message.

New prototype of Iridium SVP-BTC80/RTC/GPS temperature-profiling drifter was developed in 2009 and 3 buoys have been deployed in the Black Sea. These buoys have a few fundamental differences in contrast with former prototypes (e.g. another data format; data from 42 sensors are transmitted; 30-min repetition period; data processing inside a buoy to connect the temperature and depth of the temperature sensor, when bend of temperature chain; etc.).
New GPS receivers with faster cold start and better keeping of almanac introduced in to Iridium SVP-BTC drifters have demonstrated that there are no gaps in GPS data, even if maximum level of submergence takes place. Development of Argos-3 SVP-B mini drifter with hourly samples and two-year lifetime has been completed.

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*The Chair of the Task Team on Buoy Best Practices and Drifter Technology Developments would like to thank members for their hard work during the intersessional period, and for providing the input for this report.*

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## APPENDIX C

## REPORT BY THE TASK TEAM ON MOORED BUOYS

*(Submitted by Mr. Jon Turton, Chair of the Task Team)*

1. The Task Team on Moored Buoys was established at DBCP-23, Jeju, Republic of Korea, October 2007.

2. As agreed at DBCP-24, Cape Town, Republic of South Africa, October 2008, the initial priority for the Task Team is on documenting the existing moored buoy systems operated by participants. This is needed because there is at present no collection of the relevant information (metadata) on moored buoy systems.

3. This would include building a more complete list of sustained (both operational and research funded) moored buoy systems, detailing the systems and what parameters they measure. For example, it would be useful for data users, as well as platform operators, to know what sensors are being used (including heights of exposure), whether the winds are corrected to 10 m or not, what satellite data telecommunication systems are used, what hulls are used etc. Sharing such information could help everyone to adopt best (and hopefully more consistent) practices.

4. Specifically, at DBCP-24 it was noted it had been proposed that the JCOMM ODAS information bulletin (http://www.meds-sdmm.dfo-mpo.gc.ca/odas/main.htm) maintained by MEDS, Canada should be transferred to the JCOMM ODAS Metadata Centre (http://www.odas.org.cn/) operated by NMDIS, China. The latter is based on a Metadata structure (ODAS Metadata base Version 1.1) which includes an extensive list of variables and also covers other platforms (drifters, fixed platforms, light stations etc). However, it is not obvious that this database is up to date as concerns moored buoy systems, or includes description of all the required/relevant information. Hence it was suggested at DBCP-24 that JCOMMOPS should develop a system to collect relevant moored buoy metadata directly from the platform operators, this information could then be forwarded to the JCOMM ODAS Metadata Centre and ingested into their system.

5. The approach suggested, for discussion at DBCP-25, is that a data collection system for moored systems similar to that implemented for notification of Argo floats is developed at JCOMMOPS. This is via an intuitive (menu-driven) interface and is relatively easy to use (both for the input of data and for updating). To facilitate ease of input, such a system for moored buoys, could specify a limited number of core inputs together with optional additional parameters. Only parameters relevant to moored buoy systems would be required. However it is essential that such a system must be simple to use and intuitive, otherwise it will not be used. Also, developing such a system will have resource implications for JCOMMOPS as it may require extra staff effort to be bought in.

6. A list of metadata parameters that could be collected via such a system has been suggested (for discussion at DBCP-25), which is consistent with (but not identical to) the ODAS Metadata format version 1.1, such that the data collected could be used to populate the ODAS meta database using (as far as practical) the version 1.1 format field abbreviations for identification. However, not all format version 1.1 parameters are included, as not all are regarded as being relevant to moored systems. The suggested list of parameters includes a number of the parameters/descriptors for wave measurements as recommended by the JCOMM Pilot Project on Wave measurement Evaluation and Test from moored buoys (PP-WET). However, at this stage sub-surface variables have not been included, but it should be possible to follow the underlying methodology to include them.

7. Following discussion, review and agreement by DBCP of the suggested list of parameters, it would then be necessary to generate the information needed to initially populate such a database. The simplest way to do this is likely to be by generating computer-readable files for each platform that can be ingested automatically. Thereafter, system changes could be recorded via the proposed JCOMMOPS metadata interface.

## APPENDIX D

## REPORT BY THE TASK TEAM ON CAPACITY BUILDING

*(Submitted by Dr. Sidney Thurston, Chair of the Task Team)*

The Intergovernmental Oceanographic Commission (IOC) has identified the Western Indian Ocean as one of the highest Priority Regions for Capacity Building in 2009. As the IOC celebrates its 50th anniversary in 2010, beginning with its roots of the *International Indian Ocean Expedition* of 1960, it is timely that after half a Century this basin is once again receiving the spotlight and attention that it deserves.

During the October 2008 DBCP-XXIV Meeting, hosted by the South African Weather Service (SAWS) in Capetown South Africa, the DBCP CB-TT met to discuss options forward to address this IOC priority and to advance operational oceanography and applications for the Region.

Specifically, plans are currently underway for a Regional Capacity Building workshop for the Western Indian Ocean (WIO) in early 2010. Objectives are to increase the flow of useful products to the Region by optimizing ocean observations in the Region to help satisfy the needs of Modellers for quality and resolution (space, time, parameter). The workshop will focus on data collection and management, as well as modelling, products and validation by in-situ ocean observations.

A number of Regional Institutions have met to discuss potential training options to put forward for the planned DBCP WIO Capacity Building Workshop and have expressed an interest to participate in the proposed training and capacity building; UNESCO/IOC,
Seychelles Meteorological Department and Seychelles Fisheries, Mauritius Meteorological Department and Mauritius Oceanographic Institution, Mozambique Meteorological Department and INAHINA, Mozambique, Tanzania Meteorological Agency, ASCLME, NOAA, Institute of Marine Science, University of Dar es Salaam, Tanzania and others.

It is anticipated that the Capacity Building Workshop will consist of two Parallel Sessions: 1) "data collection/ management", 2) "modelling/products and validation", with common Joint sessions for modellers to convey their ocean observation data requirements for assimilation into models.

For "data collections/management" sessions, continuity and extension from the earlier successful DBCP capacity building Workshop in Oestend will be used as the foundation. For "modelling/products and validation", the IOC is coordinating with ongoing modellers from local Institutes for local scales of practical socio-economic importance.

Major Regional needs are currently being identified where this DBCP training can assist. Topics of importance will include; the use of fixed and drifting buoy data for national and regional Climate and Ocean models, both as inputs for boundary conditions and validation; training on how to deploy and maintain fixed and drifting buoys; how to access and process these data streams; grid interpretation of the data streams; and delivery of model products for practical socio-economic application. These data streams, particularly the air temperatures and wind, can be used as input for initial forecasting conditions and model validation in existing regional climate models to improve the model skills.