WORLD METEOROLOGICAL ORGANIZATION

DATA BUOY COOPERATION PANEL

THIRTY-FIRST SESSION

GENEVA, SWITZERLAND
19-23 OCTOBER 2015

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

DBCP-31 / Doc. 7
(2-Oct-15)

ITEM: 7

ENGLISH ONLY

REPORTS BY ACTION GROUPS

(Submitted by Action Groups)

SUMMARY AND PURPOSE OF DOCUMENT

The document includes in its appendices the reports from the DBCP Action Groups on their respective activities during the last intersessional period.

ACTION PROPOSED

The Meeting is invited to note the information contained in this document when discussing how it organises its work and formulates its recommendations.

Appendix:
A. Report by the International South Atlantic Buoy Programme (ISABP)
B. Report by the Network of European Meteorological Services (E-SURFMAR)
C. Report by the International Buoy Programme for the Indian Ocean (IBPIO)
D. Report by the International Tsunameter Partnership (ITP)
E. Report by the DBCP-PICES North Pacific Data Buoy Advisory Panel (NPDBAP)
F. Report by the Tropical Moored Buoy Implementation Panel (TIP)
G. Report by the International Arctic Buoy Programme (IABP)
H. Report by the WCRP-SCAR International Programme for Antarctic Buoys (IPAB)
I. Report by the Global Drifter Programme (GDP)
J. Report by the Ocean Sustained Interdisciplinary Timeseries Environment observation System (OceanSITES)

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DISCUSSION

-A- DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

7.1 Under this agenda item, the Panel was presented with reports by the DBCP Action Groups. Each group maintains an observational buoy program that supplies data for operational and research purposes. The implementation of buoy deployments is also coordinated through global, regional, or specialized Action Groups.

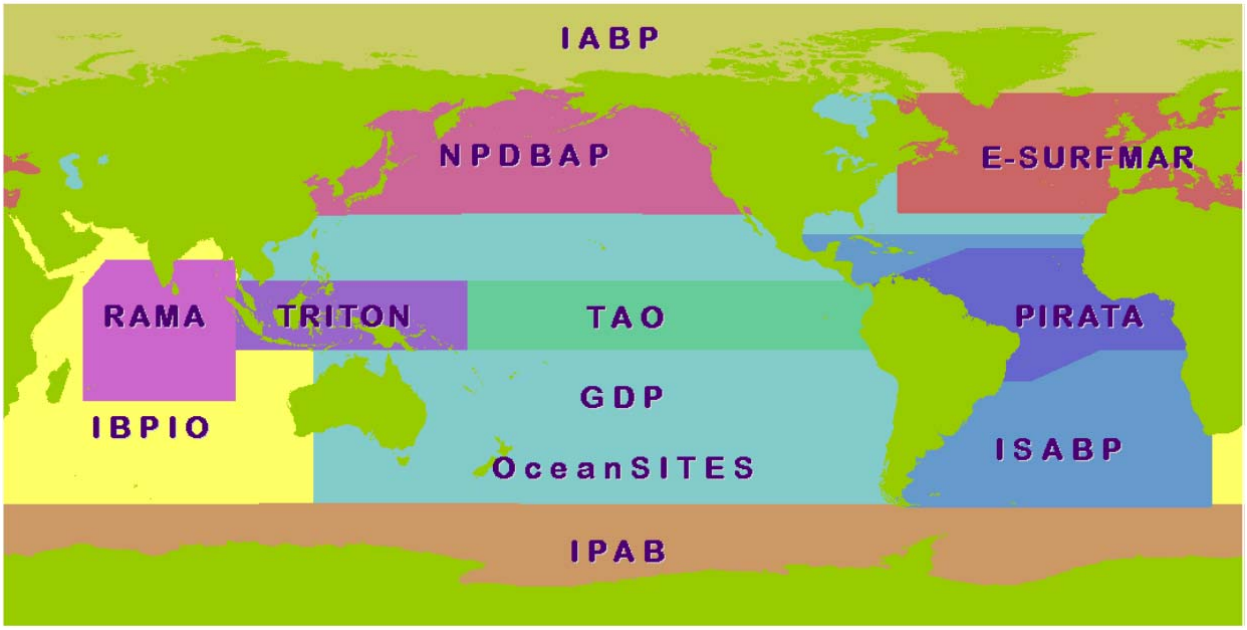

Figure 1: The regional extent of several of the DBCP Action Groups.

7.2 The reports included:

(i.) **E-SURFMAR**: Surface Marine programme of the Network of European Meteorological Services, EUMETNET (verbal presentation by Jean Roland (France), representing the E-SURFMAR officers);
(ii.) **GDP**: Global Drifter Programme (verbal presentation by Rick Lumpkin (USA) on behalf of the GDP);
(iii.) **IABP**: International Arctic Buoy Programme (verbal presentation by Dr. Ignatius Rigor (USA), representing IABP);
(iv.) **IBPIO**: International Buoy Programme for the Indian Ocean (verbal presentation by Mr Graeme Ball (Australia), Chairperson of the IBPIO);
(v.) **IPAB**: WCRP-SCAR International Programme for Antarctic Buoys (verbal presentation by Petra Heil (USA) on behalf of the IPAB);
(vi.) **ISABP**: International South Atlantic Buoy Programme (verbal presentation by Mayra Pazos (USA), representing the ISABP);
(vii.) **NPDBAP**: DBCP-PICES North Pacific Data Buoy Advisory Panel (verbal presentation by Mr Shaun Dolk (USA), technical coordinator of the NPDBAP);
(viii.) **OceanSITES**: OCEAN Sustained Interdisciplinary Timeseries Environment observation System (verbal presentation by the Technical Coordinator, Champika Gallage, representing OceanSITES project office);
(ix.) **TIP**: Tropical Moored Buoys Implementation Panel (verbal presentation by Dr Iwao Ueki (Japan) on behalf of the TIP);
(x.) **ITP**: International Tsunameter Partnership (verbal presentation by Dr Venkatesan (India) on behalf of the ITP).

7.3 The full reports of the action groups are provided in Appendices A to J, and will be reproduced in the Panel's Annual Report.

Appendices: 10

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7.4 Xxxxx

7.5 Xxxxx

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

(i.) Rec1;

(ii.) Rec2;

(iii.) Rec3;

(iv.) Rec4;

(v.) Rec5.

7.7 **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)*

APPENDIX A

ISABP
International South Atlantic Buoy Programme

1) Summary

Name of Action Group	ISABP
Date of report	31 August 2015, submitted by Mayra Pazos, NOAA/AOML/GDP
Overview and main requirements addressed	The main objective of ISABP is to establish and maintain a network of platforms in the Tropical and South Atlantic Ocean in order to provide meteorological and oceanographic data for both real-time and research purposes. The task includes support to the World Weather Watch Programme (WWW), the Global Climate Observing System (GCOS), the World Climate Research Programme (WCRP), and the Global Ocean Observing System (GOOS), as well as to the research activities of participating institutions.
Area of interest	South Atlantic Ocean north of 55S plus Tropical Atlantic Ocean up to 20N (90° W to 30° E)
Type of platform and variables measured	Lagrangian drifters measuring sea level pressure, SST, salinity and sea-surface velocity
Targeted horizontal resolution	5 degrees x 5 degrees
Chairperson/Managers	Felipe Santos, DHN, Brazil
Coordinator	Mayra Pazos, NOAA/AOML, USA
Participants	Countries interested in the region (Brazil, US, Argentina, South Africa, Tristan Is.)
Data centre(s)	Historical drifter data are assembled, quality controlled at AOML, Miami, USA then sent to ISDM (Canada, GDAC for drifters) for archival and further distribution. Real time data is also archived at ISDM. GTS quality control is handled by AOML GDP.
Website	http://www.jcommops.org/dbcp/isabp/index.html http://www.oceatlan.org/isabp/en/
Meetings *(meetings held in 2014/2015; and planned in 2015/2016)*	Starting in 2014, ISABP meetings are held during DBCP. Last Meeting took place on October 28, 2014 in Weihai, China. A similar meeting is planned this year during DBCP-31 in Geneva, on October 20, 2015.
Current status summary *(mid-2015)*	As of August 24, 2015, there were a total of 184 drifters in the South Atlantic Region (49 SVP and 135 SVPB), a total of 27 more than last year around the same time of the year (Figure 1). Brazilian Navy plans to have 10 moored buoys along the coast, as of August 2015, 7 are operational, one 1 is planned for deployment in 2015 (Figure 3).
Summary of plans for 2016	Continue to address observational gap areas, continue to increase the number of SVPB drifters in the region.

2 Deployment plans for 2016

Details on deployment plans, and opportunities for next year.

Deployments during the last year (July 2014 through June 2015) are shown in Figure 1.
There were a total of 124 drifters deployed in the region,(15 less than last year), 45 SVP (compared to 52 SVP last year), 78 SVPB (compared to 81 SVPB last year) and 1 with salinity sensors (versus 6 last year). Of the total number, only one failed on deployment (compared to 16 failed on deployment last year), 15% are Iridium drifters. Efforts to populate hard to reach areas (i.e. Gulf of Guinea and Angola Basin) continued during the intersessional period. Deployments were carried out by US vessels, the Brazilian Navy, South Africa Weather Service (SAWS), the Falkland Islands Fisheries Department, Tristan da Cunha, South Thule fishing vessels and several others. SAWS will deploy again about 25 drifters donated by NOAA during the cruise to Gough Island, as well as other cruises in the South Atlantic area. One stationary weather buoy was deployed in Tristan da Cunha Island for consistent pressure data.

There were 53 all SVPB (compared to 49 drifters deployed last year), all SVPBs, deployed between 55° S and 65° S in the South Atlantic, this number continued this year to be larger than usual as part of a continued funded proposal for a study in this region from various groups. Most of these drifters made it to the ISABP region soon after deployment. Figure 2 shows these deployments.

The GDP deployment plan from July 1, 2015 – June 30, 2016 is as follows:

Tropical Atlantic (20S – 30N): SVP=170 SVPB=80

Extra Tropical Atlantic (400S – 200S): SVP=25 SVPB=25

Southern Atlantic (600S – 400S): SVP=0 SVPB=100

The SPURS project is officially over, therefore there is a reduction in the total number of SVPBs deployed in the Tropical Atlantic region.

Brazil plans to have 10 moored buoys operating along the coast, at the present time, seven are operational and one is planned to be deployed in 2015. Figure 4 shows this plan.

3 Data management

3.1 Distribution of the data

These data are assembled and quality controlled at the GDP Drifter Data Assembly Centre. The historical data are available through the DAC web page http://www.aoml.noaa.gov/phod/dac/dacdata.php), the near real time data (GTS data) are available through the web page: http://www.aoml.noaa.gov/phod/trinanes/xbt.html and from ISDM web page http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/drib-bder/index-eng.htm.
Brazilian Buoy Program has its data available at http://www.goosbrasil.org/produtos/pnboia.php, for moored and drifting buoys.

3.1.1 Data policy

Following current standards, ISABP promotes timely, free and open data exchange.

3.1.2 Real-time data exchange

All data from drifters are disseminated via GTS as soon as drifters are deployed. These data are monitored and taken off GTS when sensors stop giving good quality data. As of August 24, 2015, there were a total of 184 surface drifters in the South Atlantic region transmitting good quality data on the GTS. Last year there were 157 around the same time of the year.

3.1.3 Delayed mode data exchange

Updates of the raw, quality controlled and interpolated data sets are sent to ISDM, the RNODC for drifter data, once a year, for further archival and distribution.

Metadata from GDP drifters are collected at the DAC directly from the manufacturers, archived and made available on the deployment log at the DAC web page www.aoml.noaa.gov/phod/dac/deployed.html and also www.aoml.noaa.gov/phod/dac/dirall.html

3.2 Data quality

All data are quality controlled by removing bad locations from the raw data, based on speeds between consecutive locations. Deviant SST values are removed by applying a temperature change criterion relative to the recent temperature measured by the instrument. Then data values are interpolated in space and time to 6 hour intervals, using an optimal interpolation method called Kriging. (Quality Control and Interpolations of WOCE-TOGA Drifter Data, peer reviewed open literature by Hansen, D. V and P.-Marie Poulain, 1996.)

4) Instrument practices

5) Other issues as needed

Figure 3 shows the status of the drifter array in the region. As of August 24, 2015 there were a total of 184 drifters actively reporting, 49 SVP and 135 SVPBs.

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Annex (optional)

Status maps and graphics

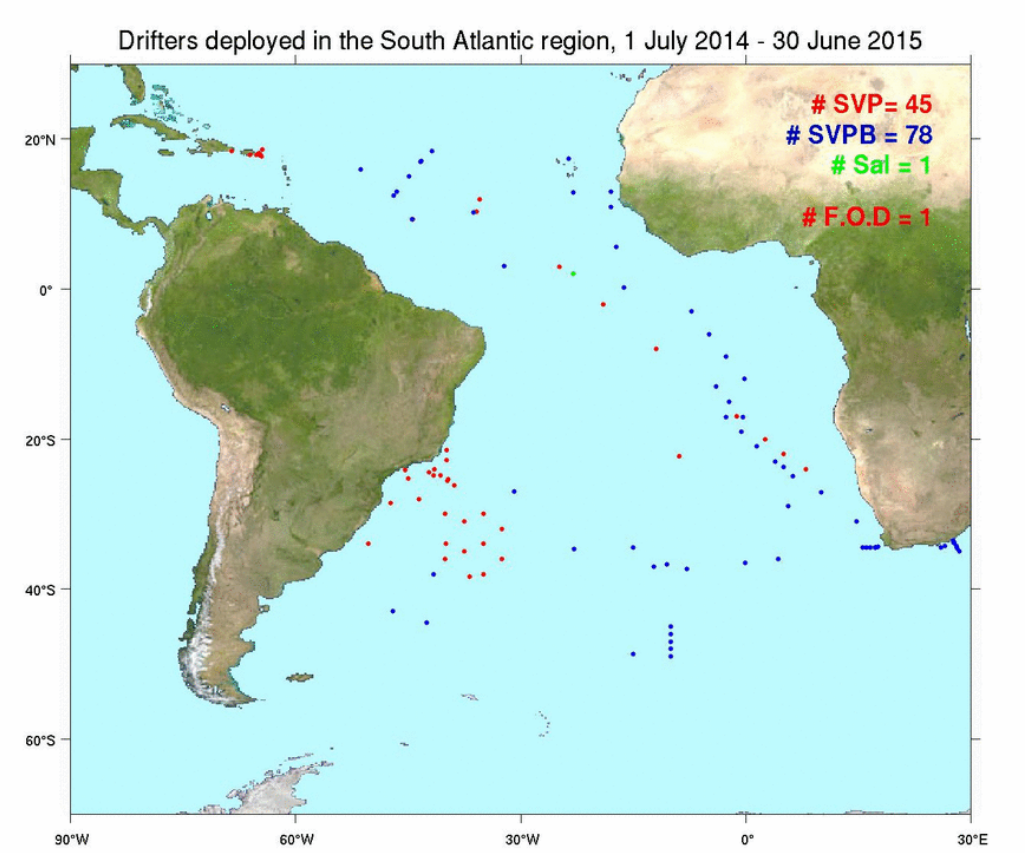


Figure 1. Deployment locations. A total of 124 drifters were deployed in the area. One fixed weather buoy was deployed on the Tristan da Cunha Island for consistent pressure data. 15% of the deployed drifters are iridium.

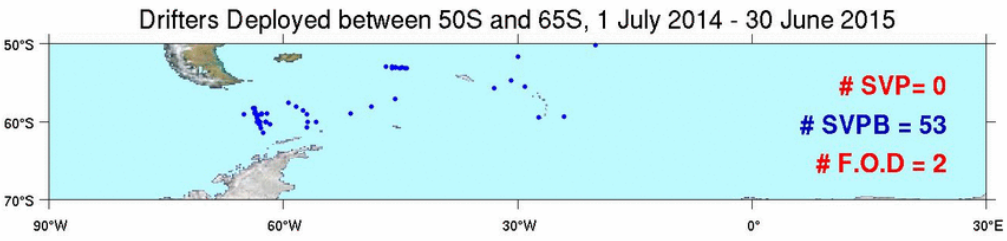


Figure 2. Deployment locations between 55S and 65S. A total of 53 drifters were deployed, all SVPBs.

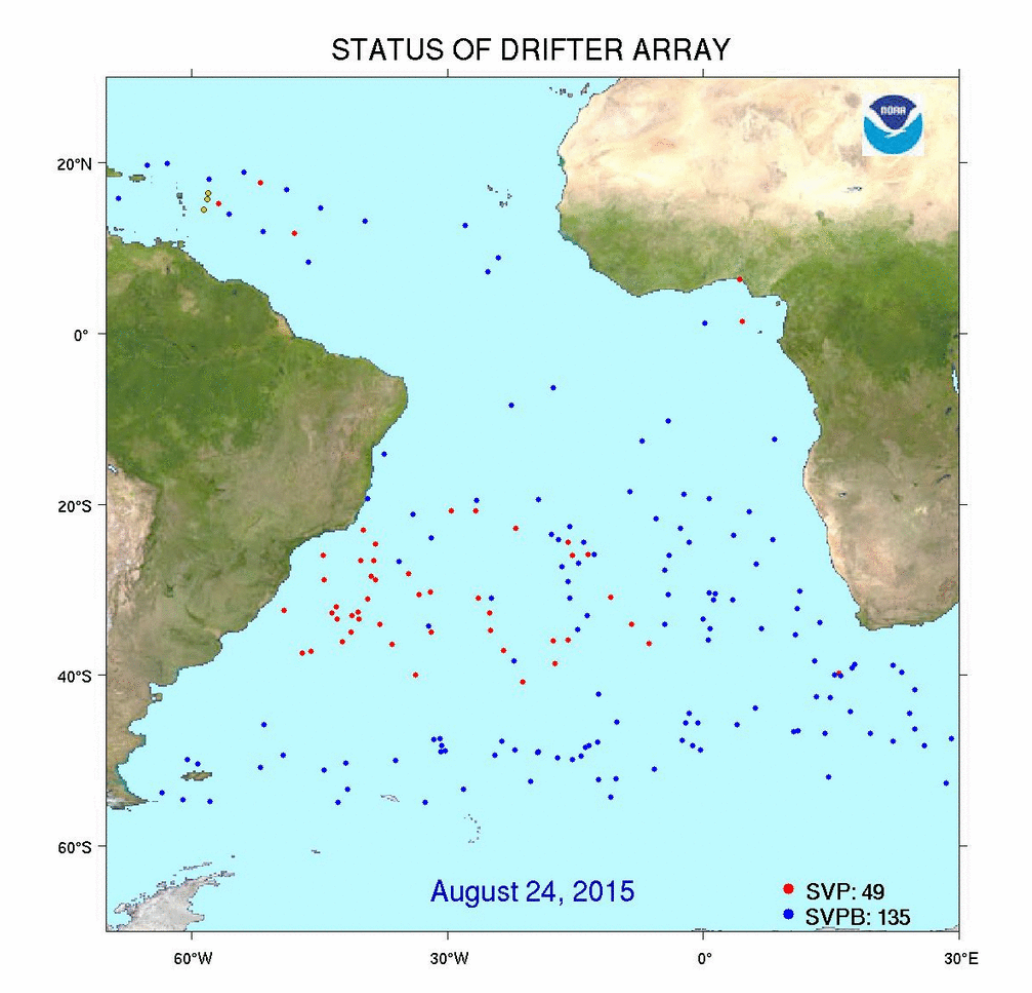


Figure 3. Status of the South Atlantic Array as of August 24, 2015.
A total of184 drifters were present in the region compared to157 last year.

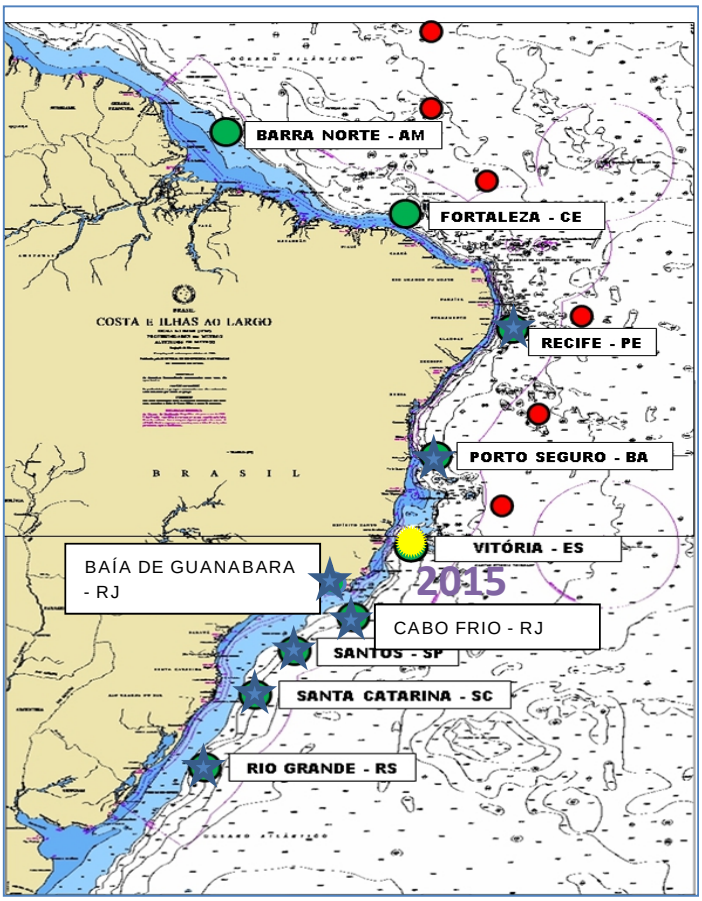


Figure 4. Brazil plans to have 10 moored buoys to be operating along the coast. As of August 2015, 7 are operational (blue symbols) and one is planned to be deployed in 2015 (yellow dot).

APPENDIX B

E-SURFMAR
Operational Service of the Network of European Meteorological Services, EUMETNET

1) Summary

Name of Action Group	Operational Service of the Network of European Meteorological Services, EUMETNET (E-SURFMAR)
Date of report	31 August 2015
Overview and main requirements addressed	The EUMETNET operational service E-SURFMAR is an optional programme involving 19 out of the 31 EUMETNET members, who fund the activity on a GNI basis. Its main objectives are to coordinate, optimise and progressively integrate the European meteorological services activities for surface observations over the sea – including drifting and moored buoys, and voluntary observing ships. E-SURFMAR is responsible for coordination of buoy activities carried out by the European meteorological services, and the programme supports a Data Buoy Manager (DBM) to manage these activities. The DBM is supported and advised by the E-SURFMAR Expert Team-Data Buoy (ET-DB). E-SURFMAR ET-DB is an action group of the DBCP.
Area of interest	Ocean areas potentially affecting NWP over European countries. This covers the North Atlantic Ocean (north of 10°N), the Mediterranean Sea and a part of the Arctic. In 2015, E-SURFMAR started to extend its activities in the South Atlantic in the frame of AtlantOS project.
Type of platform and variables measured	Drifting buoys: air pressure, SST Moored buoys: air pressure, wind, air temperature, SST, waves (directional spectra), relative humidity.
Targeted horizontal resolution	250 km x 250 km, >100 drifting buoys, 4 moored buoys for satellite calibration/validation.
Chairperson/Managers	E-SURFMAR Operational Service Manager: Mr Pierre Blouch, Météo-France Chairperson, Expert Team-Data Buoy (ET-DB): Mr Jon Turton, UK Met Office
Coordinator	E-SURFMAR Data buoy Manager: Mr Gilbert Emzivat, Météo-France
Participants	Belgium, Croatia, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxemburg, The Netherlands, Norway, Portugal, Serbia, Spain, Sweden, Switzerland, and the United Kingdom.
Data centre(s)	Météo-France as JCOMM/SOC DFO/OS (Canada) as RNODC/DB NOAA/AOML for DBCP/GDP
Website	http://www.eumetnet.eu/, http://esurfmar.meteo.fr (restricted working area web site for E-SURFMAR participants)
Meetings	ET-DB meets once a year. ET-DB12 Rome 28-29 May 2015
Current status (mid-2015)	133 E-SURFMAR drifting buoys in operation (91 Iridium including 4 AtlantOS and 42 Iridium upgrades) + 69 others reporting AP. 4 E-SURFMAR supported moored buoys in operation, plus a

	further 30 others operated by members.
Summary of plans for 2016	Maintain a network of 100 drifting buoys in North Atlantic, a network of 15 drifting buoys in South Atlantic, and the 4 reference moored buoys in operation.

2 Deployment plans for 2016

The drifting buoys will be deployed from various locations (Canada, Iceland, France, Norway, UK, USA...) in the Atlantic Ocean. Drifters from GDP are regularly upgraded with barometers and deployed in the North Atlantic Ocean by vessels plying from North America to Iceland, from North America to Europe and from Europe to North America. Within the allocated budget, more than 100 buoys (including 30 upgrades) will be deployed in the E-SURFMAR area of interest in the coming twelve months.
E-SURFMAR will set up a permanent network of 15 SVP-B in the South Atlantic in the frame of AtlantOS project. Drifters are deployed in the South Atlantic by vessels plying from France to South Africa.

E-SURFMAR will continue to deploy buoys in the Arctic Ocean in collaboration with IABP.

The 4 E-SURFMAR moored buoys K5 (59.1N – 11.5 W), M6 (53.1N – 15.9W), Cabo Silleiro (42.1N – 9.4W) and Lion (42.1N – 4.7E) are operated by United Kingdom, Ireland, France and Spain, respectively. At present, Cabo Silleiro and K5 are equipped to report directional wave spectra. Spectra data from K5 are disseminated on GTS by the Met Office

3 Data management

3.1 Distribution of the data

3.1.1 Data policy

ESURFMAR encourages free and open access to data, in the spirit of WMO data exchange policy defined in WMO Congress Resolution 40 (Cg-XII). All basic meteorological and oceanographic data are coded in the appropriate WMO code forms and disseminated on the WMO Global Telecommunication System (GTS)

3.1.2 Real-time data exchange

All the data are put on the GTS as quickly as possible.

The processing chain at Météo-France producing GTS reports from Iridium SBD data was consolidated. This chain is able to produce FM13-SHIP, FM18-BUOY or FM94-BUFR messages. The distribution of BUFR messages allows to transmit the data of the drifters having a resolution of 0.01K for SST. New OMM template for drifting buoys (TM315009) is used by “Centre de Meteorologie Marine” (CMM) at Meteo-France since th 1st of June 2015.

All the operating drifters are now using Iridium. This improves the data timeliness (see Annex). In June 2015, the number of daily observations transmitted onto the GTS was close to 3,000. The target (90%) for the percentage of data received within 50 minutes continue to be met. This results from efforts made during recent years to have all buoys reporting through Iridium.

The mean lifetime (for Air Pressure) of the SVP-B drifters increased to 368 days (357 days last year). Seventy three buoys failed to report air pressure measurements (108 last year).

The availability of moored buoy data depends on the number of buoys operating. More than 80 hourly observations per day from July to December 2014, falling down to 65 in January 2015 due to M6 ‘s

breakdown and then increasing to 85 then 75 due to Lion 's and K5 's bad transmissions , have been reported from E-SURFMAR buoys to the GTS.

3.1.3 Delayed mode data exchange

The raw data from drifters are archived at CMM.
Data inserted onto the GTS are routinely archived by various centres (for drifting buoys DFO/OS, AOML/GDP, Coriolis…, Meteorological Services for drifting and moored buoys).
Archived data from drifters are also used to produce surface currents deduced from the buoys movement on a weekly basis
The metadata collection system at JCOMMOPS is used for drifting buoys.
E-SURFMAR members are invited to compile Moored Buoy Metadata in line with the metadata variables defined on the DBCP website (http://www.jcommops.org/dbcp/data/metadata.html).

3.2 Data quality

The web page giving access to the Quality Control (QC) tools was maintained. The transmission delays onto the GTS are monitored (see http://www.meteo.shom.fr/qctools). Monthly statistics and 16-day graphs are available for all surface marine observations through the same interface. Buoys reporting in BUFR are monitored as those reporting through BUOY or SHIP alphanumeric messages. The blacklists, automatically issued for air pressure every day, are used to identify and correct potential problems.

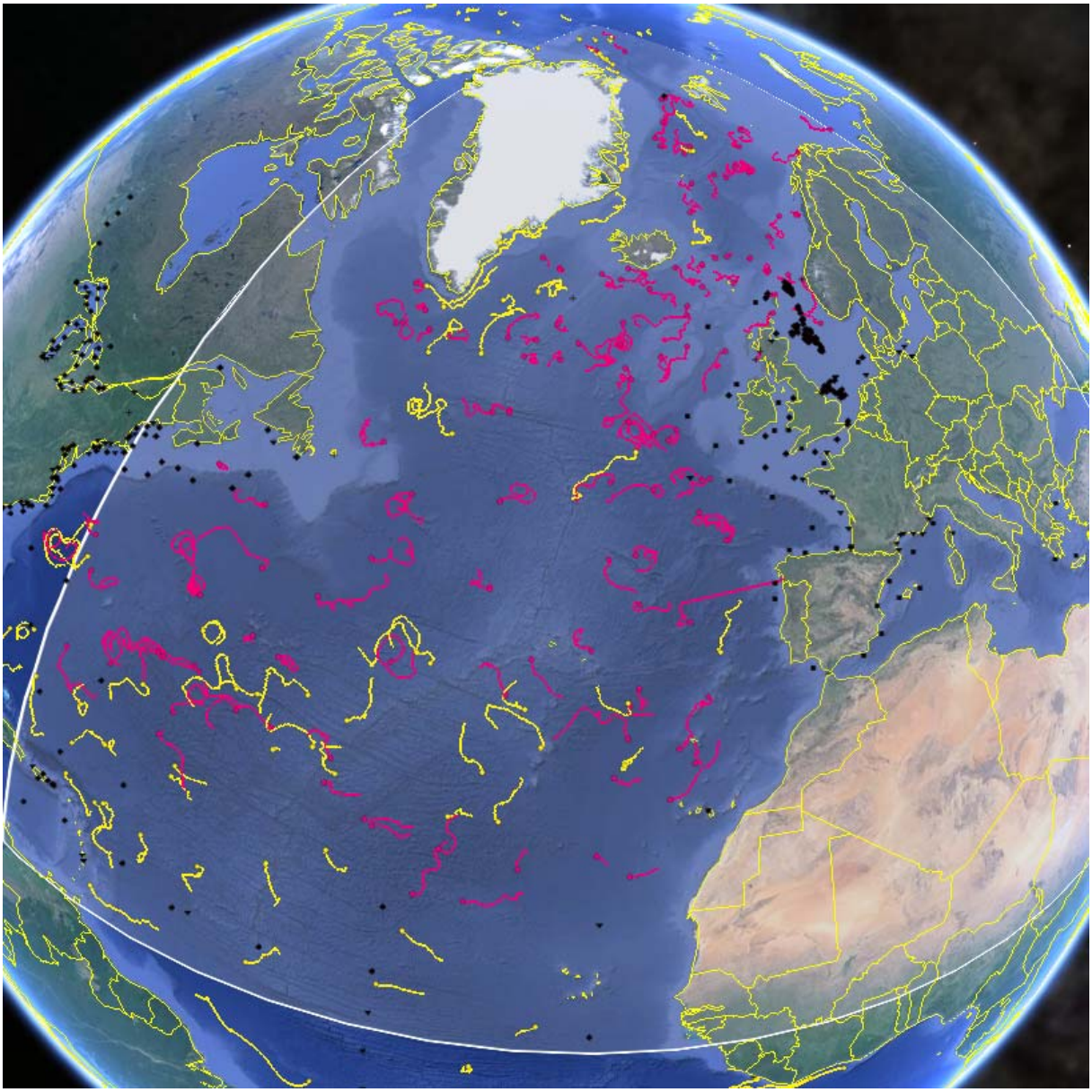
For drifters the Air Pressure (AP) differences from the French model outputs, the target of 1% of Gross Errors was achieved. The RMS of AP differences (about 0.5 hPa) still has a seasonal variation, being higher in winter than in summer.

For moored buoys the Air Pressure (AP) differences with the French the target of 0.5% of Gross Errors was achieved. The RMS of AP differences was about 0.6 hPa.

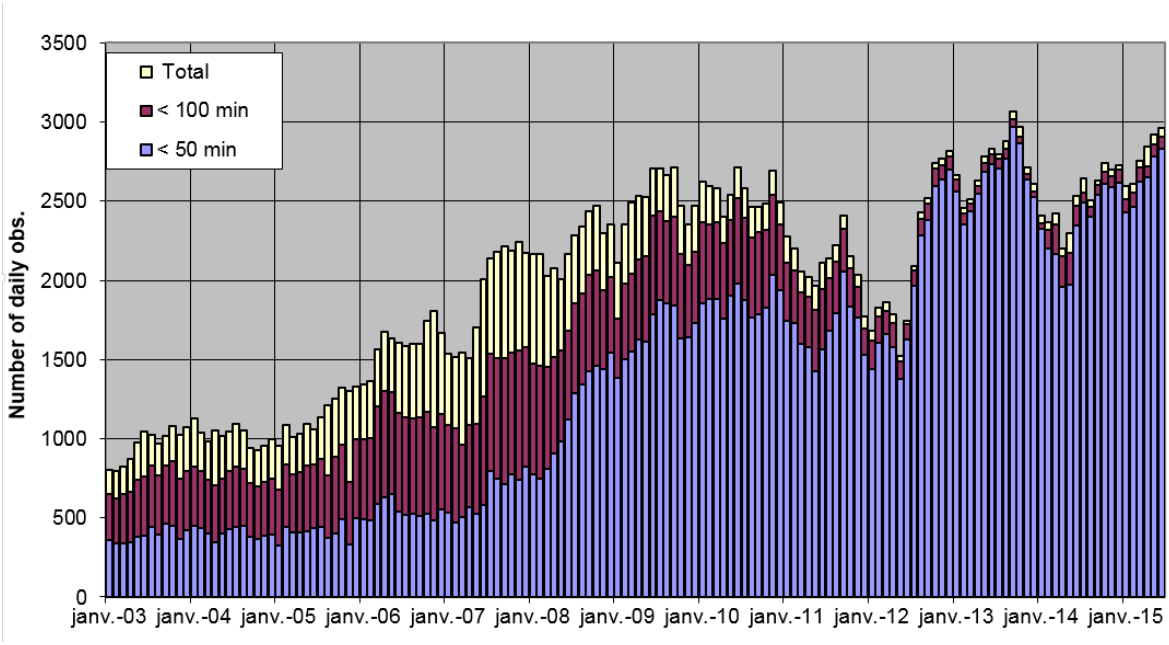
4) Instrument practices

ESURFMAR drifting buoys use recommended DBCP formats.

Annex



Drifting buoy trajectories and moored buoy positions
(June 2015)



Drifting buoys data availabilty

APPENDIX C

IBPIO
International Buoy Programme for the Indian Ocean

1) Summary

Name of Action Group	International Buoy Programme for the Indian Ocean (IBPIO)
Date of report	31 August 2015
Overview and main requirements addressed	The International Buoy Programme for the Indian Ocean (IBPIO) was formally established at a meeting in La Reunion in 1996. The primary objective of the IBPIO is to establish and maintain a network of platforms in the Indian Ocean to provide meteorological and oceanographic data for both real time and research purposes. More specifically, the IBPIO supports the World Weather Watch Programme (WWW); the Global Climate Observing System (GCOS); the World Climate Research Programme (WCRP); the Global Ocean Observing System (GOOS); tropical cyclone forecast and monitoring; as well as the research activities of the participating institutions. The programme is self-sustaining, supported by voluntary contributions from the participants in the form of equipment and services (such as communications, deployment, storage, archiving, co-ordination...).
Area of interest	Indian Ocean North of 55°S and between 25°E and 120°E (130°E in the North of Australia)
Type of platform and variables measured	Drifting buoys: Air pressure, SST, (wind) Moorings: air pressure, wind, air temperature, SST, waves, relative humidity, radiation, rainfall, SSS, subsurface temperature and salinity, current…
Targeted horizontal resolution	500 km x 500 km
Chairperson/Managers	Mr Shaun Dolk, NOAA/AOML, USA
Coordinator	Mr Gilbert Emzivat, Météo-France
Participants	Australia (ABOM), France (Météo-France), India (NIO, NIOT, INCOIS), Kenya (KMD), Mozambique (EMU), South Africa (SAWS), TIP (Tropical Moored Buoy Implementation Panel), USA (GDP, Navoceano).
Data centre(s)	ISDM (Canada) as RNODC/DB, Météo-France as SOC AOML, NOAA/PMEL
Website	http://www.shom.fr/meteo/ibpio
Meetings	Annual meetings in conjunction with DBCP meetings. IBPIO 18 in Geneva (Switzerland) in October 2015
Current status (mid-2015)	154 drifters (131 with Air Pressure) 48 moored buoys (34 for RAMA 74% of the planned 46 site array)
Summary of plans for 2016	Maintain a network of 150 drifters at least.

	Maintain or expand the moored buoy arrays.

2 Deployment plans for 2015-2016

IBPIO participants are regularly encouraged to maintain their contributions of buoys, or to fund barometers to equip SVP drifters provided by GDP. Météo-France, ABOM and SAWS, regularly, fund barometer upgrades in the Indian Ocean. About 190 drifters are planned to be deployed during the next intersessional period, of which 1/3 at least will be equipped to transmit through Iridium (Action by ABOM, GDP, Météo-France).

Efforts are aimed at filling data gaps in the tropical regions, primarily during the Tropical Cyclone season. In the southern tropical area the buoys are provided by NOAA/GDP and will include about 10 (Iridium) barometer upgrades funded by Météo-France. The ABOM is likely to deploy 15 drifting buoys between the central Indian Ocean and the Australian coast. NIO plans to continue to provide and deploy drifters in the Arabian Sea and in the Bay of Bengal (about 14 in 2014-2015).

RAMA maintenance will continue in the coming year with a potential for participation by up to 6 countries in support of up to 39 moorings. The number of research vessels in the Indian Ocean capable of mooring maintenance is limited. The number of moorings actually serviced will be dependent on the availability of ship time. The U. S. plans to use a vessel from the Seychelles for the first time in fall of 2015 to support 2 nearby RAMA sites, one of which will be occupied for the first time, bringing the number of sites implemented to 35 (76% of the planned 46 mooring array). RAMA cruises will continue to provide deployment opportunities for surface drifters and Argo floats.

NIOT is maintaining a network of 12 deep sea buoys with subsurface measurements radiation and precipitation sensors (Ocean Observation Systems, OOS): there are 7 sites in the Bay of Bengal and 5 in Arabian Sea. These OMNI buoys are similar to RAMA moorings but also include current measurements. Another Indian made OMNI buoy, designed to collect and transmit 104 parameters, is installed and working in Arabian Sea. These OMNI buoys systems have given new scientific in-sight into oceanic processes during cyclones in the Bay of Bengal, and provided valuable data during land fall of Cyclone Phailin, resulting in the saving of many lives. NIOT also operates 5 tsunami buoys and has installed 4 coastal buoys. A newly designed buoy with video cameras off Goa, on the west coast of India, provides live video streaming through 3G telemetry. The Indian satellite INSAT provides data calibration and validation of a twin buoy with fluorescence sensor in Arabian Sea. Additionally, 2 drifters designed by India, were successfully tested at sea using INSAT telemetry. India plans to install a mooring in Southern Ocean in 2016 for biogeochemical studies. Under an INDO US collaborative project, one FLUX mooring by WHOI USA will be installed in Bay of Bengal during November 2014

In the southern part of the Indian Ocean (South of 40S), the deployment of SVP-B drifters provided by GDC and upgraded by Météo-France (about 15 Iridium units) should continue. The ABOM expects to deploy 13 SVP-B drifters in this area over the next 12 months including 8 upgrades. These deployments will be supported by opportunity ships leaving La Réunion during their rotations between La Reunion, Crozet, Kerguelen and Amsterdam Islands.

In addition to the drifters upgraded by Météo-France and ABOM, GDC plans to provide SVP-B drifters for deployment in the Southern Indian Ocean.

In the sub-tropics (between the Tropic of Capricorn and 35 S) the ABOM will most likely deploy 6 SVP-B, including 2 near the Indian Ocean Gyre.

The SAWS plans to obtain buoys on behalf of South Africa : 10 will be used as part of research studies on the formation of eddies within the Mozambique Channel, 5 will be kept for the IIOE-II and the deployment of these will be done in consultation with DEA (Oceans and Coast), Annual SANAP cruise to Marion Island and Buoys to be deployed on behalf of the Bureau of Meteorology in Australia (BOM) if provided, 5 be used for deployment on the SAMBA line during Marion Island logistical cruise

in April/May 2016 and or any other SAMBA line voyage if no buoys received from BOM for deployment during the Marion voyage. The ABOM plans to provide 2 SVP-B buoys for deployment from these scheduled voyages in 2016.

As in previous years, the GDP remains the biggest contributor to the IBPIO, with about 150 planned drifters deployments (upgrades included).

3 Data management

3.1 Distribution of the data

3.1.1 Data policy

IBPIO encourages free and open access to data, in the spirit of WMO data exchange policy defined in WMO Congress Resolution (Cg-XII). All basic meteorological and oceanographic data are coded in the appropriate WMO code form and inserted to the Global Telecommunication System (GTS)

3.1.2 Real-time data exchange

All the data are placed on the GTS as quickly as possible.

The processing chain at Météo-France producing GTS reports from Iridium SBD data is maintained. The chain is able to produce FM13-SHIP, FM18-BUOY or FM94-BUFR messages.

The use of the Iridium communication system continued. Thirty nine drifters using Iridium were deployed (123 last year). This improves the data timeliness. One hundred and thirty four drifting buoys (296 last year) were deployed of which about 85% measured air pressure (SVP-B). The number of daily observations on the GTS decreased to 2900 by June 2015 (see Annex) due to the decline in number of operating drifters. In June 2014, the number of daily observations was about 5000. At the end of June 2015, the percentage of data received within 50 minutes is about 65%, due to the use of the Iridium system and the improvment of the Argos system in respect of timeliness.

In June 2015, 15 of 27 RAMA surface moorings were reporting on the GTS (WMO ID's 23003, 23004, 23005, 23006, 23007, 23008, 23009. 23010, 23015, 23016, 53006, 53009, 53040, 53056, 53057). PMEL will begin replacing some RAMA ATLAS sites with a newer T-Flex mooring system in 2015. T-Flex data will use Bulletin Header IOBX08 KPML.

In June 2015, 14 deep sea NIOT moored buoys (8 in Bay of Bengal and 6 in Arabian Sea) were reporting.

3.1.3 Delayed mode data exchange

Data are routinely archived by various centres (for drifting buoys ISDM, GDP, Coriolis…, Meteorological Services for drifting and moored buoys).

Archived data from drifters are also used to produce surface currents deduced from the buoys movement on a weekly basis

The metadata collection system at JCOMMOPS is used for drifting buoys.

PMEL's Tropical Moored Buoy website displays and distributes the RAMA data (http://www.pmel.noaa.gov/tao/rama/).
INCOIS's website displays Indian moored buoys availability and data (http://www.incois.gov.in/portal/datainfo/mb.jsp).

3.2 Data quality

The transmission delays onto the GTS are monitored through the Météo-France QC tools webpage: http://www.meteo.shom.fr/qctools. Monthly statistics and 14-day graphs are available for all surface marine observations through the same interface. Buoys reporting in BUFR are monitored in the same manner as those reporting through the BUOY or SHIP character-based codes. The blacklists, automatically issued for air pressure every day, are used to identify and correct potential problems.

The number of daily messages sent onto the GTS decreased from 5000 to about 3000 during the intersessional period.

For drifters the Air Pressure (AP) differences from the French model outputs were lower than 0.5% of Gross Errors (except during winter period). The RMS of AP stand about 0.6 hPa.

4) Instrument practices

IBPIO drifting buoys uses recommended DBCP formats (DBCP-M2 for Argos, formats published on Iridium PP website for Iridium).

NIOT is following best of practise method vetted by NOAA MPEL and NDBC.

Technical Memoranda comparing data from ATLAS, T-Flex and Bailong mooring systems are in preparation.

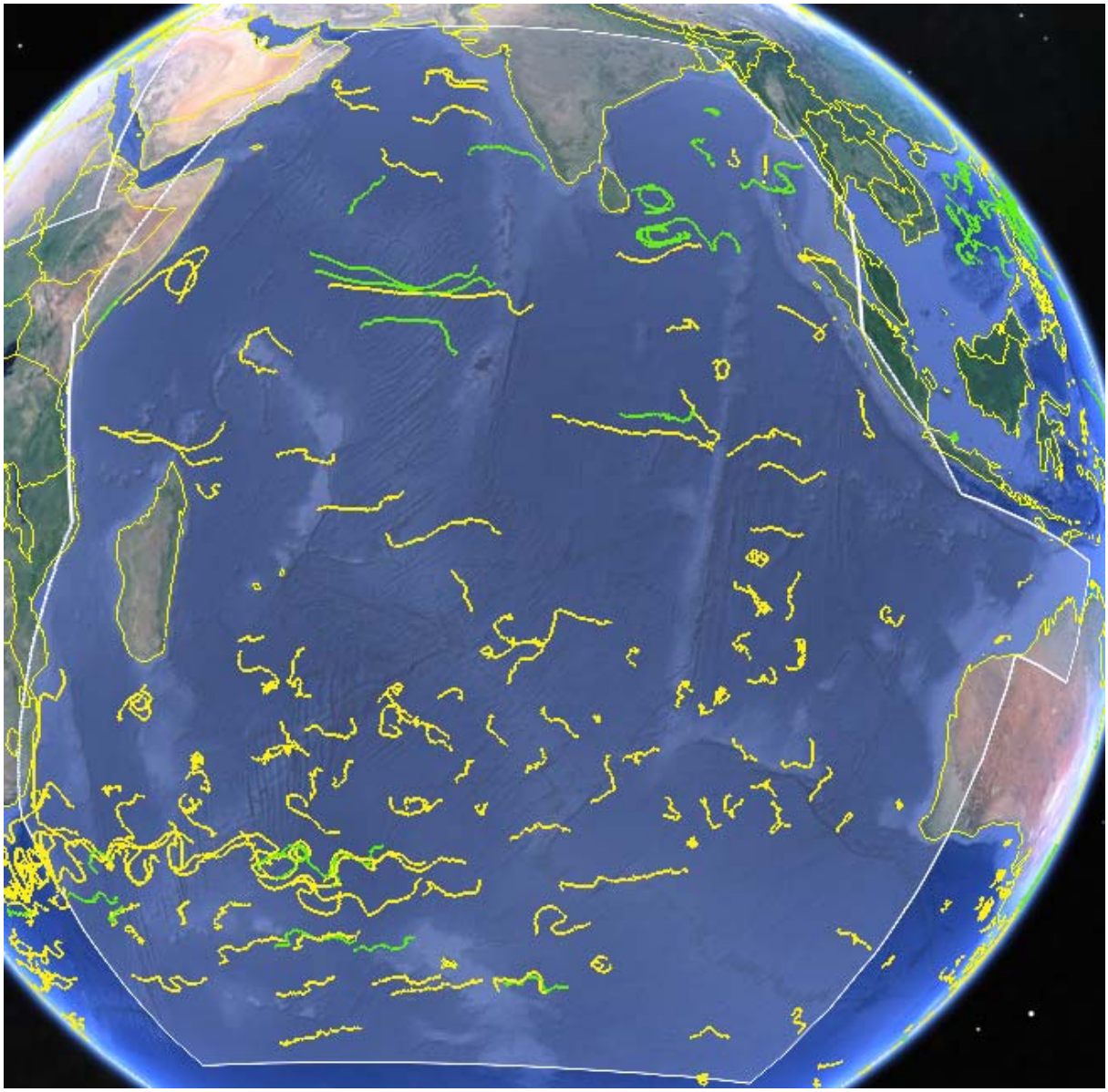
5) Issues: maintenance of moored buoys

In the past 12 months 18 RAMA surface moorings and 4 RAMA ADCP moorings were serviced. Between July 2014 and June 2015, 147 sea days were provided in support of RAMA sites. Sea days were provided by Japan, India, and Indonesia. Two new RAMA mooring sites were implemented, 1 ATLAS and 1 ADCP, both near 0°, 67°E. Thirteen (13) surface drifters and 40 Argo floats were deployed on RAMA cruises in the past year.

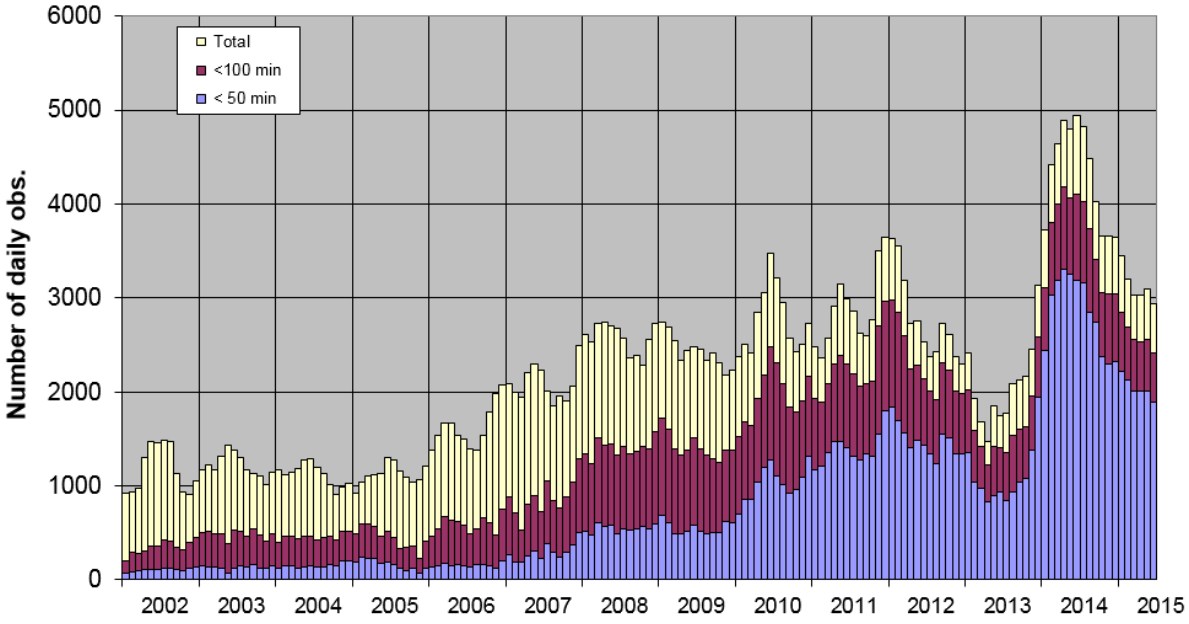
A PMEL ATLAS mooring in the Bay of Bengal was enhanced to include CO_2 measurements for the second year in a row. This effort was a collaborative effort of PMEL, BOBLME and NIOT.

Damage to buoys and theft of instrumentation continues to be a problem, especially at sites near areas of intense fishing activity. In addition to vandalism, well-publicized piracy events have resulted in the suspension of RAMA implementation off Africa and in the Arabian Sea. The occurrence of piracy has decreased in recent years and events have largely been limited to areas near the Somalia coast and the Gulf of Aden. Despite the decline, Lloyds of London has not reduced the size of their Exclusion Zone. Based on the reduction in risk, RAMA cruises aboard Indian research vessels in the central equatorial Indian Ocean were conducted in 2014 without embarking sea marshals for security and will continue so as long as threat levels remain low.

ANNEX



Drifting buoys trajectories (June 2015)



Drifting buoys data availability

APPENDIX D

ITP
International Tsunami Partnership

1) Summary

Name of Action Group	**International Tsunami Partnership (ITP)**
Date of report	15 August 2015
Overview and main requirements addressed	Activity since last report (DBCP-30): status of Tsunameters; (appendix A); issues/enhancements to data sharing, technological developments, challenges, other
Area of interest	Discussion Topic 1: Advancements in Sensing Technology Discussion Topic 2: How Observations are used in Warning Infrastructures
Type of platform and variables measured	Surface expressions (buoys and autonomous vehicles) and deep ocean water level recording devices
Targeted horizontal resolution	IOC Tsunami Programme:
Chairperson/Managers	Dr. Venkatesan,; Mr. Stephen G. Cucullu
Coordinator	Champika Gallage
Participants	DBCP Representatives
Data centre(s)	Various
Website	http://www.jcomm.info/index.php?option=com_oe&task=viewEventRecord&eventID=1638
Meetings *(meetings held in 2015; and planned in 2015/2016)*	Held: **PTWC -- 50th International Tsunami Symposium** http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1911:ptws-50th-international-tsunami-symposium-2015&catid=2153:its-2015&Itemid=2596 **Meeting of International Tsunami Experts** June 28 - July 2, 2015; Prague, Czech Republic. Upcoming: **Regional Marine Instrumentation Center (RMIC) 29 Feb 2016 - 2 March 2016 Bay St. Louis, MS**
Current status summary *(mid-2015)*	Refer to Appendix A
Summary of plans	Refer to Section 2.

for 2015	

2 Deployments Accomplished 2014/2015 & plans for 2016

Summary of accomplishments/plans for 2015:

Indian Tsunami Buoy network

India is maintaining 7 units out of which five Tsunameters are installed in Bay of Bengal and two are installed in Arabian Sea and two agencies National Institute of Ocean Technology NIOT and Indian National Center for Ocean Information Services INCOIS are associated. NIOT maintains five Tsunameters comprises NIOT designed system with Bottom Pressure Recorder from Sonardyne UK and performance of these systems is very satisfactory. Other two units are from SAIC USA through INCOIS. Sagar Bhoomi is Indian version of Tsunameter using INMARSAT. New buoy is designed and tested at sea for one year having extended service period.

Science Applications International Corporation (SAIC) had a number of significant accomplishments during the last year. SAIC was awarded a major contract by the Indian National Centre for Ocean Information Services (INCOIS) to build and deploy four SAIC Tsunami Buoy –Mid Frequency (STB-MF) systems. The four STB-MF systems have been delivered to Chennai and are awaiting deployment in the Bay of Bengal in November, 2015. SAIC is also upgrading three existing INCOIS STB systems to STB-MF systems.

SAIC also delivered an STB-MF System to NOAA's National Data Buoy Center (NDBC) in March 2015. This STB-MF system will be deployed in the Gulf of Mexico in the August-September 2015 timeframe. To date, SAIC has produced and delivered 35 Tsunami Buoy systems (STBMF, STB, and ETD DART) for its customers in Australia, Chile, China, India, Japan, Russia, Thailand and NOAA NDBC. Two additional systems have been produced and are available in inventory for rapid delivery. In addition to buoy production, SAIC provided reconditioning services for previously deployed tsunami buoy systems, as well as replacement parts and components.

In 2015, SAIC's license with NOAA to use DART Technology was renewed and upgraded to an exclusive license. SAIC is the only company authorized by NOAA to use DART Technology in its commercial tsunami buoy systems. Additionally SAIC worked with NOAA PMEL to transition PMEL's Generation Four (4G) Near Field technology into its commercial systems. The 4G enhancements include a new pressure sensor and software that run PMEL detection and filter algorithms allowing transmission of tsunami height data while the earthquake is still active, thereby increasing warning time to the potentially affected communities. Additionally, component obsolescence issues (e.g., acoustic modems, electronics, and counting board) in the earlier DART systems have been addressed. In July 2015, SAIC delivered its first 4G BPR, payloads and transducers to PMEL for deployment off of the coast of Chile scheduled for September 2015.

NWS Signed Tsunami Cooperation Agreement with Chile on June 19, 2015 NWS Deputy Director, signed a Memorandum of Understanding with the Chilean Navy - Servicio Hidrographico y Oceanografico (SHOA) on June 19, 2015, to enter into a joint project to test two new-generation tsunami buoys on the seismically active Chilean Trench. The project to launch two DART® (Deep-ocean Assessment and Reporting of Tsunamis) Generation 4 buoys represents an important milestone for the NOAA Tsunami Program in advancing international contributions to the Pacific Tsunami Warning System that relies on NOAA sensing networks and the Pacific Tsunami Warning Center for tsunami forecasting information. Chile will supply the ship time and maintenance for the 5-year project and NOAA will provide the expertise, equipment, communications, and both countries will share the data to create tsunami forecasts that will serve the entire regions. Because the trench off Chile is one of the most active in the Pacific and responsible for a deadly tsunami in 2010, having these experimental DARTs over the active zone should provide more lead time for people to respond if there is a tsunami event; these improved forecasts can save lives in Chile and across the Pacific.

Deployment plans for 2015:

Indian network would be maintained and systematic cruises are planned. Indian would be deploying fully Indian made prototype Tsunameter in December 2015

SAIC/NDBC In November 2015, SAIC will deploy four STB-MF systems in the Bay of Bengal for INCOIS. On the same cruise, SAIC will recover one STB system which will be reconditioned and upgraded to an STB-MF system and used to replace the Arabian Sea STB in March 2016. DBCP-31/INF. 8 - 2 - The STB-MF produced for NOAA's National Data Buoy Center (NDBC) will be deployed in late summer of 2015, in the Gulf of Mexico, replacing WMO station 42429 and identified as station 42409.

3 Data management

3.1 Data sharing:

SAIC currently supports tsunami buoy programs in 8 countries: Australia, Chile, China, India, Japan, Russia, Thailand, and the United States. All but one country shares its data on the GTS. For those countries that send their buoy data initially to NOAA, NDBC immediately makes the data available over the GTS and also sends the files (.ftp) directly to the host country through the internet.

3.1.1 Data policy

Data policy Distribution of the data (USA) -- The NOAA National Data Buoy Center receives data from its buoys via Iridium constellation. The data are delivered to the National Weather Service Telecommunications Gateway (NWSTG) which then distributes the data in real-time to two Tsunami Warning Centres (TWCs) via NWS communications and nationally and internationally via the Global Telecommunications System. The bottom pressure recorders of US owned buoys may be placed in high resolution event mode via two way communications initiated by the TWCs or NDBC mission control centre personnel. Indian tsunami buoy data sets are delivered to Indian Ocean Tsunami Warning Centre INCOIS

Distribution of data has been largely centralized in the west with other partners relying on localized distribution and more of a regionalized approach. Through agreement with NOAA, Russia, Thailand, and Chile have provided the data feed to NOAA-NDBC and the US TWCs. The data for those partners' stations are displayed on the NOAA-NDBC Website. The control of high resolution data or "event mode triggering" for those stations remains with the host countries. Several additional countries make their data available to the GTS (refer to the annex).

3.1.2 Real-time data exchange

As shown in the Annex, a significant portion of the users are making their real time data available through the GTS. There continues to be a positive trend and is a notable event in international collaboration. Approximately, 77 percent of the deployed Tsunameters are providing data through the GTS. India is making data available through GTS to NDBC website

Many occasions Indian Buoy data is not shared through DBCP web site due to technical issues which are rectified later. Considering importance this should be addressed

TAO data arriving on the GTS is in a manufacture specific "DART" format. Therefore, meteorological data produced from TAO buoys are not used in regular forecast models by many met centers. This shortcoming will be eliminated by using BUFR template to report the data to the GTS. However due to unique system features and resource limitations faced by TAO operators, currently there are no foreseeable plans to use BUFR template to distribute TAO data to the GTS in near future.

3.2 Data quality

Data quality SAIC's efforts to modularize and enhance cross-compatibility of STB-MF and SAIC Easy-to Deploy (ETD) DART systems along with improvements to electronics and buoy design has resulted in continuing high levels of data quality and reliability. Discounting two occurrences where

moorings were cut by vandalism, system reliability for the entire deployed fleet of SAIC systems increased to 98% in 2015.

4) Instrument practices

4.1 High Rate Data Collection Platforms (HRDCPs)

There are currently several organisations that use Standard Rate Data Collection Platforms (SRDCPS), for the transmission of tide-level data, via the Meteosat series of satellites operated by EUMETSAT

Short Presentation by Wil Doran EUMETSAT

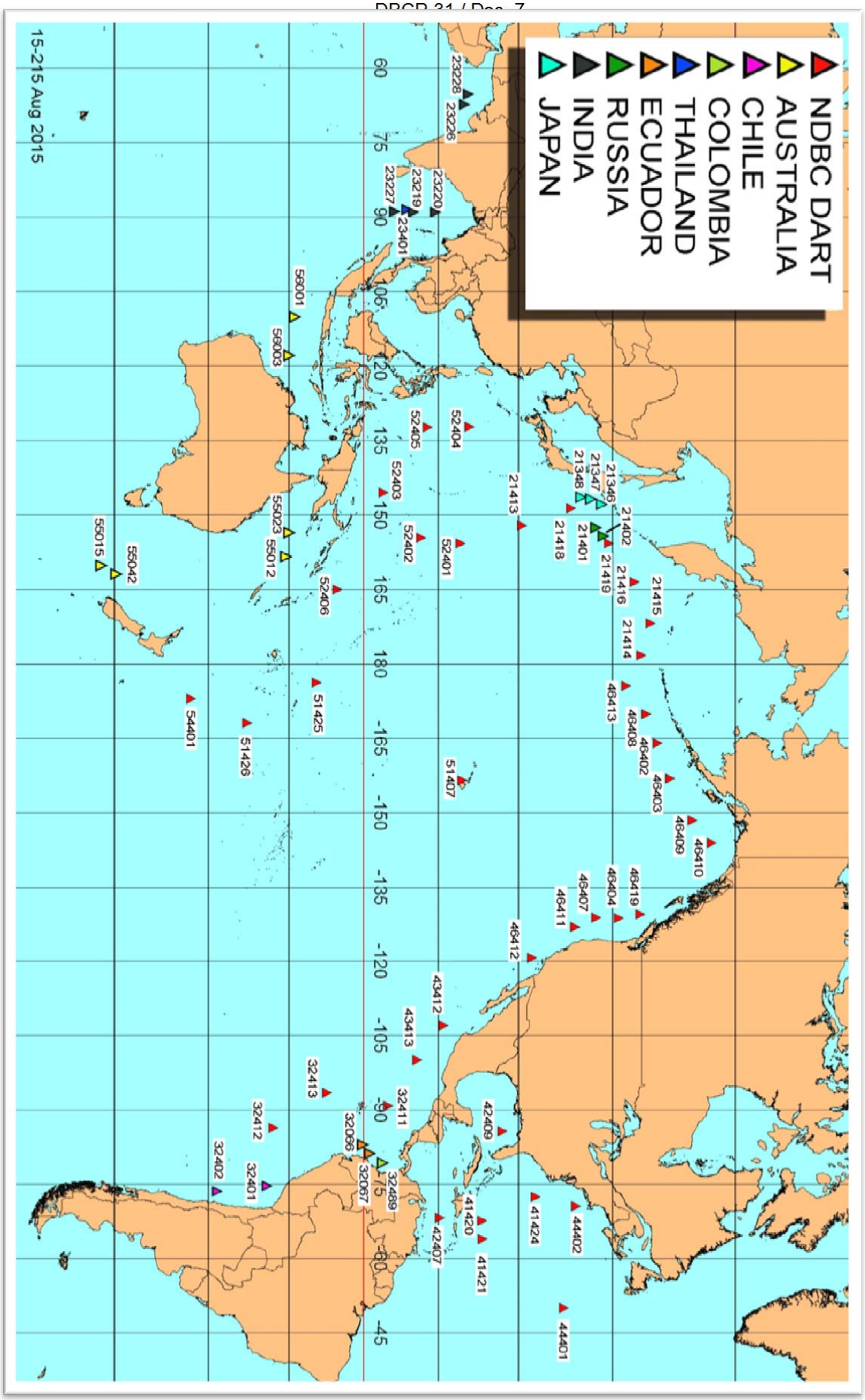
5) Other issues as needed

Action Item 1: Finalization of ITP Tsunameter Standard; for promulgation as finished document. See Document in JCOMM Standards and Best Practices.
Action item 2 : Data formatting BUFR

Annex (optional)

Status maps and graphics

Global Tsunameter Network								
Country	Planned Network	Currently Operational	Tsunameter Types	Local Reception	Data to GTS	Data to FTP	Data Formats	Vandalized Stations
Australia	6	4	SAIC - STB SAIC - ETD	Yes	Yes	No	NOAA-DART BUFR/CREX	Yes; 1 event
Chile	4	2	SAIC - DART - II SAIC - STB PMEL 4G Near Field	Yes	Yes	Yes	NOAA-DART	-
China	2	2	DART - STB	Yes	No	No	NOAA-DART BUFR	Yes; 3 - 5 events
Colombia	1	1	EBM22TS Mediterráneo Señales Marítimas (MSM)	Yes	Yes	Yes	NOAA-DART	-
Ecuador	2	0		Yes	Yes	Yes	NOAA-DART	-
India	7	7 5 NIOT 2 SAIC	SAIC-STB Indian Buoy Sagar Bhoomi - Sonardyne	Yes	Yes INCOIS	No	BUFR/CREX	-
Indonesia	14	-	InaBuoy SAIC-ETD	Yes	No	No	Local Format NOAA-DART	-
Japan	3	3	SAIC-STB-MF	Yes	Yes	No	CREX	-
Malaysia	3	-	-	Yes	No	No	-	-
Republic of Korea	2	-	-	-	-	-	-	-
Russia	2	1	SAIC-STB SAIC-ETD	No	Yes	Yes	NOAA-DART	-
Thailand	3	1	SAIC-STB Environtec	No Yes	Yes Yes	Yes No	NOAADART -	No No
USA	39	32	DART - II	Yes	Yes	Yes	NOAA-DART	No


NDBC DART
AUSTRALIA
CHILE
COLOMBIA
THAILAND
ECUADOR
RUSSIA
INDIA
JAPAN
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APPENDIX E

NPDBAP
DBCP-PICES North Pacific Data Buoy Advisory Panel

1) Summary

Name of Action Group	DBCP-PICES North Pacific Data Buoy Advisory Panel (NPDBAP)
Date of report	31 August 2015
Overview and main requirements addressed	The goals of the NPDBAP are to deploy 60 SVPB drifters a year, and maintain 75 active buoys in the region.
Area of interest	North Pacific Ocean and marginal seas generally north of 30°N
Type of platform and variables measured	Lagrangian drifters measuring sea level pressure, SST, and sea-surface velocity
Targeted horizontal resolution	5° x 5°
Chairperson/Managers	Co-Chairperson for the NE Pacific: Chris Marshall, MSC, Canada Co-Chairperson for the NW Pacific: Position vacant and to be proposed by PICES
Coordinator	Mr Shaun Dolk, NOAA / AOML
Participants	Chris Marshall, Shaun Dolk, Ignatius Rigor, and Champika Gallage
Data centre(s)	Drifter Data Assembly Centre (DAC) Integrated Science Data Management (ISDM), Canada
Website	http://dbcp.jcommops.org/npdbap/
Meetings *(meetings held in 2014/2015; and planned in 2015/2016)*	Yearly meetings usually held in conjunction with DBCP meetings. Next meeting planned 20 October, 2015 in Geneva, Switzerland
Current status summary *(mid-2013)*	From 01 September 2014 to 31 August 2015, 110 drifters were deployed in the North Pacific Ocean. Of the 110 drifter deployments, 74 units were equipped with barometer sensors and the remaining 36 drifters were standard SVP type drifters.
Summary of plans for 2016	The goal for 2016 is to deploy 100 drifters, of which, 70 drifters will be equipped with barometer sensors.

2 Deployment plans for 2016

Both the GDP and Environment Canada will continue to utilize ships of opportunity for drifter deployments, while also looking for new possibilities within the Canadian and United States Coast Guards.

3 Data management

3.1 Distribution of the data

The drifter Data Assembly Center (DAC) assembles, quality controls and interpolates data from approximately 1300 drifters per month from all GDP national and international partners, from all oceans of the world. These data are made available through the web with a delayed time of 3—4 months. As of the time of writing this report (August 2015), data are available through March 2015. These data can be accessed at http://www.aoml.noaa.gov/phod/dac/dacdata.php.

3.1.1 Data policy

The DAC, located at NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) has access to drifters from GDP partners that have given Service Argos permission to make these data available to the DAC. In return the partners have access to all quality controlled and interpolated data available in the database via the World Wide Web. Non-interpolated quality controlled data and raw data are made available via ftp transfer upon request.

3.1.2 Real-time data exchange

All data from drifters in the GDP's programs are disseminated via GTS as soon as drifters are deployed. The GDP monitors data going out on the GTS, and transmissions of sensors producing bad data or transmissions from grounded drifters are removed from the GTS data stream.

The GDP does not monitor GTS data timeliness and relies on operational centres to report on these issues.

3.1.3 Delayed mode data exchange

Drifter data (raw Argos data, edited non-interpolated and interpolated data) are archived at AOML. These datasets are also sent once or twice a year with a 6-month delay to Integrated Science Data Management (ISDM), the RNODC for drifter data, for permanent archival and further distribution. The DAC is currently preparing to send data through June 2015 to ISDM.

Metadata for GDP drifters are received at the DAC directly from drifter manufacturers who send standardized specification sheets for batches of identical drifters prior of delivery of the instruments. Portions of this metadata are extracted and are made available on the deployment log at the DAC web page www.aoml.noaa.gov/phod/dacdeployed.html. Specification sheets are archived at the DAC. Deployment date, date of last transmission, drogue off and cause of death metadata are determined during quality control of the dataset and are made available through the web at www.aoml.noaa.gov/phod/dac/dirall.html. These web pages are interrogated by JCOMMOPS to gather information for their metadata systems.

3.2 Data quality

4) Instrument practices

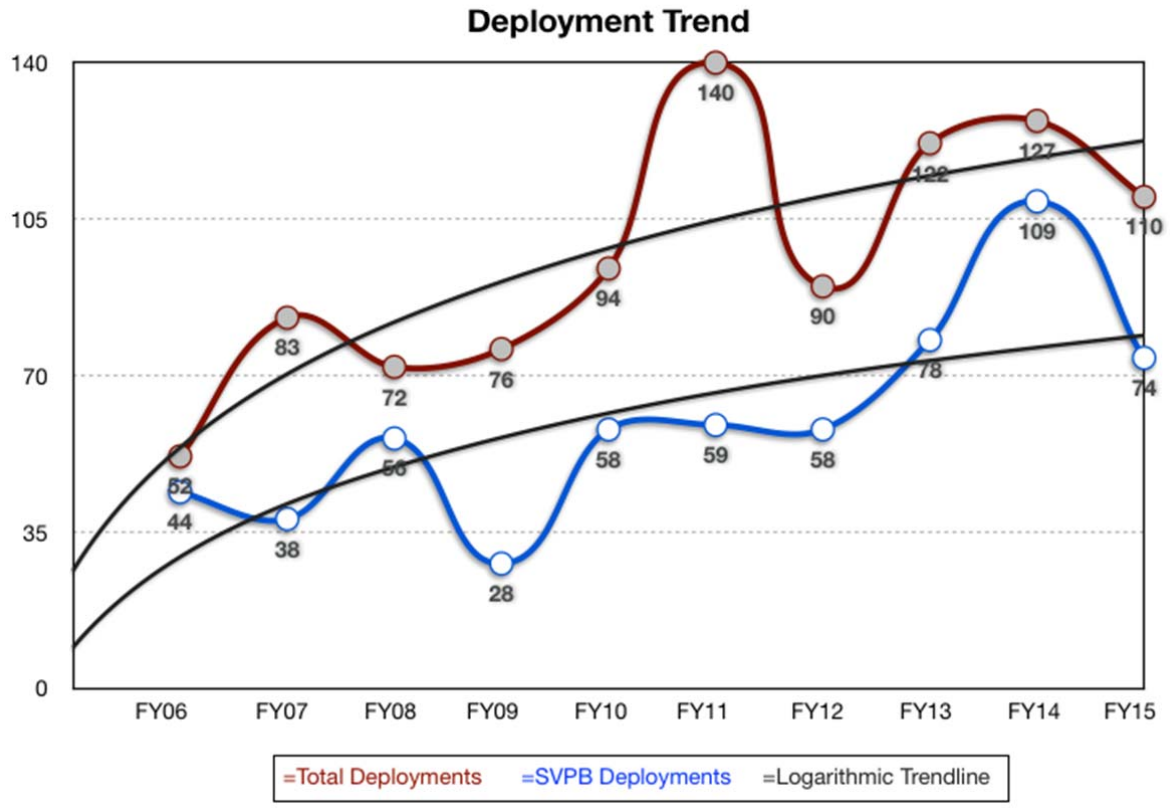
5) Other issues as needed

_____

Status maps and graphics

Deployment Trend

	Total	SVPB	SVP	SVPW	SVPBW	SVPG
FY2006	52	44	6	0	2	0
FY2007	83	38	44	1	0	0
FY2008	72	56	16	0	0	0
FY2009	76	28	35	0	0	13
FY2010	94	58	13	1	0	22
FY2011	140	59	81	0	0	0
FY2012	90	58	32	0	0	0
FY2013	122	78	44	0	0	0
FY2014	127	109	18	0	0	0
FY2015	110	74	28	0	0	8



APPENDIX F

TIP
The Tropical Moored Buoy Implementation Panel

1) Summary

Name of Action Group	The Tropical Moored Buoy Implementation Panel (TIP)
Date of report	15 September 2015
Overview and main requirements addressed	The Tropical Moored Buoy Implementation Panel (TIP) oversees the design and implementation of the following components: • The Tropical Atmosphere Ocean / Triangle Trans-Ocean Buoy Network (TAO / TRITON), a central component of the ENSO Observing System, deployed specifically for research and forecasting of El Niño and La Niña; • The Prediction and Research Moored Array in the Tropical Atlantic (PIRATA) • The Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA)
Area of interest	The tropical ocean regions as part of an integrated approach to observing the climate system to address the research needs of CLIVAR and the operational strategies of GOOS and GCOS. Pacific Ocean: 8°N to 8°S; Atlantic Ocean: 20°N to 10°S; Indian Ocean: 15°N to 25°S.
Type of platform and variables measured	Tropical moorings with surface meteorological and sub-surface oceanographic sensors measuring: Surface wind, air temperature, relative humidity, SST and SSS on all surface moorings. Air pressure, precipitation, short wave radiation, long wave radiation on some surface moorings. Sub-surface temperature profiles down to 500m-750m on all surface moorings. Salinity profiles as deep as 750m on some surface moorings. Current velocity on some moorings. Also, biogeochemical measurements, including CO_2 and O_2 on select moorings. Some moorings also have specialized instruments to measure turbulence dissipation and listening devices for tracking marine animals. Subsurface ADCP moorings measuring velocity profiles in the upper few hundred meters. Some have additional single point current meters at deeper levels.
Targeted horizontal resolution	Tropical Pacific Ocean: 67 moorings; Tropical Atlantic Ocean: 19 moorings ; Tropical Indian Ocean: 46 moorings
Chairperson/Managers	Dr. Mike McPhaden, PMEL, USA, Chairman Dr. Kentaro Ando, JAMSTEC, Japan, Vice-Chairman
Coordinator	Mr H. Paul Freitag, PMEL, USA
Participants	TAO/TRITON: NOAA National Data Buoy Center (NDBC),NOAA Pacific Marine Environmental Laboratory (PMEL), Japan Agency for Marine-Earth Science and Technology (*JAMSTEC)* PIRATA: NOAA PMEL, NOAA Atlantic Marine Oceanographic Laboratory (AOML), L'Institut de recherche pour le développement (IRD), Meteo-France, Instituto Nacional de Pesquisas Espaciais (INPE), Diretoria de Hidrografia e Navegacao (DHN**)**

	RAMA: NOAA PMEL, JAMSTEC, Indian National Center for Ocean Information Services (INCOIS), Indian National Institute of Oceanography (NIO), the Indonesian Agency for the Assessment and Application of Technology (BPPT), the Indonesian Meteorological, Climate, and Geophysical Agency (BMKG), the Chinese First Institute of Oceanography (FIO), Agulhas and Somali Current Large Marine Ecosystems (ASCLME), Bay of Bengal Large Marine Ecosystem (BOBLME) program, University of Tasmania and the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia.
Data centre(s)	PMEL, NDBC,JAMSTEC, NIO
Website	http://www.pmel.noaa.gov/tao/global/global.html
Meetings *(meetings held in 2014/2015; and planned in 2015/2016)*	• CLIVAR GOOS Indian Ocean Panel 11th session, The Hague, Netherlands, 14-15 July 2014 • CLIVAR Pacific Ocean Panel, The Hague, Netherlands, 14-15 July 2014 • Ninth Annual Indonesia – U.S. Ocean and Climate Observations, Analysis and Applications Partnership Workshop, Jakarta, Indonesia, 20-23 August 2014 • TPOS-2020 Steering Committee 1st meeting, Ansan, Korea, 6-9 October, 2014 • IndOOS Resource Forum, Phuket, Thailand, 31 October 2014 • PIRATA-19/Tropical Atlantic Climate Variability, Recife, Brazil, 3-6 November 2014 • Tenth Annual Indonesia – U.S. Ocean - Climate Observations, Analysis and Applications Partnership Workshop, Bandung, Indonesia, 12-14 August 2014 • PREFACE-PIRATA-CLIVAR Tropical Atlantic Conference, Cape Town, South Africa, 25-27 August, 2015 • CLIVAR Pacific Ocean Panel10th session, Santiago, Chile, 10-11 October, 2015 • TPOS2020 Steering Committee 2nd meeting, Hobart, Australia, 14-17 October, 2015 • CLIVAR GOOS Indian Ocean Panel 12th session, IndOOS Resource Forum, Goa, India, 5-9 December, 2015
Current status summary *(September 2015)*	TAO/TRITON: 51 of 55 TAO, 8 of 8 TRITON surface moorings reporting data. PIRATA: 18 of 18 surface moorings reporting data. RAMA: 16 of 27 surface moorings reporting data.
Summary of plans for 2016	TAO/TRITON: Maintain 61 mooring array. (11 of 13 original TRITON/ADCP moorings retired.) PIRATA: Maintain 18 mooring array RAMA: Maintain 34 sites, including 2 new sites. Possibly implement additional sites if ship time is available.

2 Deployment plans for 2016

TAO/TRITON: NDBC 4 cruises, JAMSTEC 1 cruise
PIRATA: AOML/PMEL 1 cruise, IRD 1 cruise, INPE 1 cruise
RAMA: PMEL/INCOIS 3 cruises, PMEL/Seychelles 1 cruise, JAMSTEC 1 cruise, NIO 1 cruise, PMEL/BPPT/BKMG 1 cruise, FIO/BPPT 1 cruise

3 Data management

3.1 Distribution of the data

Most surface mooring data are telemetered in real time and are placed on the GTS. High resolution TAO Refresh data (the NDBC systems now in TAO that have replaced PMEL Autonomous Temperature Line Acquisition System [ATLAS] systems) are telemetered via Iridium and placed on the GTS by NDBC. TRITON data and data from ATLAS moorings (the majority of systems in PIRATA, and RAMA) are telemetered via the Argos system and are placed on the GTS by the French Space Agency (CLS). Real-time data, delayed-mode data (e.g., ATLAS data of higher temporal resolution than are available in real time) and data from subsurface moorings are available via several web based distribution sites:

PMEL (www.pmel.noaa.gov/tao/disdel/disdel.html),
NDBC (http://tao.ndbc.noaa.gov/tao/data_download/search_map.shtml),
JAMSTEC (www.jamstec.go.jp/jamstec/TRITON/real_time/delivery/
www.jamstec.go.jp/iorgc/iomics/datadisplay/buoysummary.php?LANG=0
NIO (www.nio.org/index/option/com_nomenu/task/show/tid/2/sid/18/id/5).

During the period September 2014 through August 2015 the PMEL web pages had more than 14M hits and delivered more than 376K data files in response to more than 46K user requests. In addition to web page deliveries, more than 2.2M files were delivered via FTP.

3.1.1 Data policy

Data are freely available on the web and distributed via the GTS in real-time.

3.1.2 Real-time data exchange

TAO Refresh systems, designed to make observations comparable to legacy ATLAS systems using newer, more commercially available sensors, transmit 10-min data via Iridium, with hourly observations placed on the GTS. ATLAS moorings place daily mean meteorological and oceanographic observations and some (about 10 per day on average) hourly meteorological observations on the GTS using Argos2 PTTs. TRITON and mini-TRITON (m-TRITON) buoys submit hourly mean meteorological and oceanographic data to the GTS: TRITON via Argos2 PTTs and m-TRITON via Argos3 PMTs. Compared to the volume of ATLAS data received at PMEL, more than 90% is typically reported on the GTS by CLS. Most operational centers receive nearly all ATLAS data placed on the GTS, with the exception of the ECMWF which typically reports volumes of about 75%, presumably due to stricter latency criteria.

TAO Refresh, PMEL's T-Flex (i.e., the newest generation ATLAS) and the Chinese BaiLong mooring used in RAMA telemeter data via Iridium. NDBC submits TAO Refresh data onto the GTS. PMEL has developed methods to do so for T-Flex and FIO plans for China's Meteorological Service to do so for BaiLong. TAO Refresh data are distributed under the SSVX08 KWNB header in World Meteorological Organization (WMO) FM18 – BUOY alphanumeric format. The WMO numbers for the TAO Refresh buoys are those used for the previous ATLAS moorings at the same sites. T-Flex data will be in BUFR format with Bulletin Header IOBX08 KPML. WMO numbers for T-Flex moorings will take the 7-digit analog of the 5-digit code for the previous ATLAS system at the same site. For example, the WMO number for the first T-Flex mooring implemented (4°S 81°E in RAMA) will be 2300010 (vs 23010 for the previous ATLAS moorings at that site).

Daily average real-time data return for the period 1 September 2014 through 31 August 2015 was 81% for TAO, 82% for TRITON, 87% for PIRATA and 49% for RAMA. As reported last year, the number of TAO moorings maintained from mid-2012 to mid-2014 was significantly lower than normal levels. As a result, data return plummeted to levels as low as 30%. Resumption of annual service of all sites in 2014 has resulted in annual data return comparable to historical norms. Primary reasons for data loss in RAMA were a high incidence of vandalism coupled with long mooring deployment periods at some sites. Details are discussed in section 5.1.

3.1.3 Delayed mode data exchange

Delayed mode data (*i.e.,* data retrieved after mooring recovery) are archived at the web sites listed in 3.1 above. System metadata are available at the web sites listed in 3.2 and 4 below.

The TAO web sites (http://www.pmel.noaa.gov/tao/ and http://tao.ndbc.noaa.gov/), PIRATA web site (http://www.pmel.noaa.gov/pirata/), and RAMA web site (http://www.pmel.noaa.gov/tao/rama/) provide additional information including scientific background, technical information, present status of the arrays, a bibliographies of refereed publications, history of cruises, and additional information.

3.2 Data quality

Data quality control procedures are described at www.pmel.noaa.gov/tao/proj_over/qc.html and http://tao.ndbc.noaa.gov/proj_overview/qc_ndbc.shtml for ATLAS moorings and at www.jamstec.go.jp/jamstec/TRITON/real_time/overview.php/po.php for TRITON moorings.

4) Instrument practices

Sensor specifications and calibration procedures are described on a number of web sites:

- www.pmel.noaa.gov/tao/proj_over/sensors.shtml
- http://tao.ndbc.noaa.gov/proj_overview/sampling_ndbc.shtml
- http://www.jamstec.go.jp/jamstec/TRITON/real_time/overview/
- http://www.jamstec.go.jp/iorgc/iomics/projectoverview/1_b3_eng.html

After testing and comparison of real-time (daily averaged) and delayed mode (10-minute) data alongside ATLAS moorings for several years, NDBC's TAO Refresh moorings have replaced ATLAS Legacy moorings at 54 of 55 TAO sites. Replacement of the remaining mooring has been delayed due to the inability to obtain clearance from the Solomon Islands to conduct research in their exclusive economic zone, and is being planned for 2016. Refresh systems telemeter 10-min resolution data via Iridium each hour, and data are placed on the GTS.

RAMA mooring specifications from PMEL, JAMSTEC and NIO are also listed in the Supplement to RAMA: The Research Moored Array for African—Asian—Australian Monsoon Analysis and Prediction (McPhaden, et al., 2009)

China's First Institute of Oceanography (FIO) mooring, named BaiLong (White Dragon), was designed to make meteorological and ocean measurements comparable to ATLAS moorings. FIO first deployed a BaiLong at the 8°S 100°E RAMA site in February 2010 and maintained the site on an annual basis until 2015. FIO plans to re-establish the mooring in 2016. PMEL and FIO have incorporated data from the BaiLong mooring into PMEL's Tropical Moored Buoy web pages which display and distribute RAMA data from ATLAS and TRITON moorings.

PMEL's T-Flex mooring system, intended to replace the legacy ATLAS moorings in RAMA and PIRATA, is essentially equivalent to ATLAS, while using more commercially available components and providing higher temporal resolution data in real time. Eight prototype systems have been deployed for comparison with ATLAS systems. The first replacement of an ATLAS system occurred in August 2015 at the 4°S 81°E RAMA site. Additional replacements of ATLAS with T-Flex systems in RAMA and PIRATA are planned for later in 2015 and in 2016.

PMEL and FIO conducted a land-based, side-by-side test of meteorological sensors from ATLAS, T-Flex and BaiLong moorings in 2014 to ensure compatibility of measurements within RAMA. A NOAA Technical Memorandum on the test will be published in 2015.

5) Other issues

5.1 RAMA Implementation and Maintenance

The number of RAMA sites implemented stands at 34 (74% complete). Two new moorings (ATLAS moorings near 4°S, 57°E and 16°S, 95°E are planned for the coming year.

Between July 2014 and June 2015, 153 sea days were provided by India, Japan, Indonesia, and China in support of RAMA. During this period 23 RAMA moorings were deployed (18 surface and 5 subsurface). As of September 8, 2015, 16 of 27 surface moorings were reporting data.

Due to lack of cruise opportunities 10 of 27 surface mooring sites have not been maintained for 17 months or more. Others which were maintained in 2015 had not been previously visited since 2012-2013. Moorings lacking timely maintenance are typically those far from RAMA cruise ports, e.g., those south of 5°S. Data return for 14 sites which have been maintained on a roughly annual basis was 70%. Vandalism and long deployments also lower RAMA mooring survival rates. The survival rate for ATLAS moorings in RAMA since initial deployments in 2004 is 81%, compared to 90% for TAO (1980 to 2010) and 93% for PIRATA (September 1997-April 2015).

NIO has ceased maintenance of their Deep Ocean RAMA mooring at 0°, 93°E.

PMEL has identified a small ship in the Seychelles with the potential for mooring maintenance on a limited number of sites near 55°E. A test cruise in November 2015 is planned during which 2 RAMA ATLAS moorings will be deployed.

5.2 Array enhancements

Meteo-France provides barometers to maintain surface pressure measurements at 4 RAMA sites and 1 PIRATA site.

CO_2 and additional biochemical (e.g., pH, O_2, chlorophyll, turbidity) measurements are made on some TAO moorings (http://www.pmel.noaa.gov/co2/moorings/) and on some PIRATA buoys by LOCEAN (http://www.lodyc.jussieu.fr/CO2tropiques/) and the Leibniz Institute of Marine Sciences at the University of Kiel (IFM-GEOMAR). China's BaiLong moorings deployed in RAMA included CO_2 measurements in 2011 and 2012, and are scheduled to resume in 2016. A PMEL CO_2 system supported by the Bay of Bengal Large Marine Ecosystem Project (BOBLME) was been maintained on a RAMA mooring since November 2013. The University of Tasmania has provided fluorometers for two RAMA moorings in the past.

Dalhousie University's Ocean Tracking Network (OTN) program has deployed acoustic telemetry receivers on all but one PIRATA surface moorings and 4 RAMA moorings, adding additional biological monitoring capabilities to the array by tracking marine animals. Additional deployments on RAMA and TAO moorings are planned.

Oregon State University continues to deploy microstructure measuring instruments (known as ChiPods) on tropical moorings in TAO, PIRATA and RAMA. At present a total of 33 instruments are deployed on 9 moorings.

Enhancements to PIRATA moorings, to include adding current meters to some moorings and increased vertical resolution of salinity profiles, are planned for 2017.

5.3 International cooperation and capacity building

A number of formal bilateral agreements have been created between agencies of the United States, India, Indonesia, Australia and ASCMLE to help complete and sustain RAMA. A 5-year Implementing Arrangement between NOAA and the Indonesian Ministry of Marine Affairs and Fisheries (KKP) expired in 2013. A new Implementing Arrangement between NOAA and Indonesia's Meteorological, Climate, and Geophysical Agency (BMKG) has since been developed. The ASCLME Project ended in March, 2014. A program named SAPPHIRE to continue work in the area is being developed.

To facilitate and coordinate resources that may be applied to the Indian Ocean Observing System, an IndOOS Resource Forum (IRF) was established in 2009. The Forum held its fifth meeting in October 2014 in Phuket, Thailand and will hold its sixth meeting in Goa, India, in December 2015.

The Korea Institute of Ocean Science & Technology (KIOST) maintains 3 subsurface ADCP moorings near TAO moorings along 165ºE. This work is being conducted under the context of a Joint Project Agreement between NOAA and the Ministry of Oceans and Fisheries, Republic of Korea. The 3rd "Korea-US Oceanic and Atmospheric S&T Workshop" was held in Vienna, VA, USA on 30 May 2014. Proposals are being solicited for a Korea-US cooperation project named "Blue Ocean". Korea plans to launch a new research vessel in 2016, with interest being expressed towards support of RAMA.

Dr. Chunlin Ning from FIO's BaiLong mooring project visited PMEL for six-months in 2014 during which time he participated in the met sensor comparison test mentioned section 4 above. Dr. Ning also joined a PMEL/AOML PIRATA cruise in January 2015.

As T-Flex moorings replace ATLAS moorings in PIRATA, PMEL technicians will participate on French and/or Brazilian maintenance cruises or host training sessions for French and Brazilian technicians at PMEL.

5.4 Research experiments

PMEL conducted a multi-year (2008-2014) process study within RAMA with the addition of 9 subsurface ADCP moorings in the region spanning 2.5°N to 4°S and 78°E to 83°E. After removal of some sites 2014 and 2015, the array will continue with 3 ADCP sites in addition to those formally in RAMA.

A new initiative, the Second International Indian Ocean Expedition (IIOE-2, 2015-2020) is under development. The Indian Ocean Observing System (IndOOS) of which RAMA is a major component will provide basin-scale, multi-year observations for IIOE-2. IIOE-2 in turn presents an opportunity to complete and enhance RAMA.

In addition to 3 Deep Ocean RAMA moorings on the equator, NIO has deployed several near-equatorial (1°N and 1°S) and in the Andaman Sea. Equatorial sites near 93°E are not presently being maintained.

JAMSTEC is developing instrumentation for use on Wave Gliders to make air-sea flux measurements. Areas of deployment will be near TRITON moorings in the southeastern RAMA array, and north of the equator in the western Pacific. Wave Gliders for Tsunami monitoring for Japan are also being developed.

5.5 Vandalism

Damage to buoys and theft of instrumentation continues to be a concern, especially at sites near areas of intense fishing activity such as the far eastern and western equatorial Pacific and equatorial Indian Ocean. In response, some TRITON sites which have been vandalized heavily are now deployed without meteorological sensors. Details and metrics of vandalism experienced in TAO/TRITON, PIRATA and RAMA are given in the DBCP Working Group on Vandalism Report. Surprising, vandalism has abated significantly in the Gulf of Guinea in recent years relative to the early days of PIRATA in the late 1990s and early 2000s.

5.6 Piracy

In addition to vandalism, well-publicized piracy events have resulted in the delay of RAMA implementation off Africa and in the Arabian Sea. Lloyds of London defines an Exclusion Zone (EZ) north of 12°S and west of 78°E in which additional premiums apply to insure commercial vessels. In response, Sea Marshalls were stationed aboard some RAMA cruises in 2012 and 2013. South Africa would not permit the RV Algoa to enter the EZ in 2013. Although pirate attacks have diminished in the past several years, both in number and distance from Somalia, Lloyds has not reduced the area of the EZ. Given the reduction in threat, Sea Marshalls have not been required on RAMA cruises entering the EZ since 2014, but anti-piracy best practices are performed. Reported pirate attacks in the Gulf of Guinea have increased in number, exceeding those in the Indian Ocean. While primarily occurring in near shore waters and far from PIRATA moorings, these reports are of concern for future cruises that use ports in the region.

	2010	2011	2012	2013	2014	2015 (through August)
Vessels Hijacked	51	27	7	0	0	0
Vessels Boarded	16	17	1	0	0	0
Vessels Fired Upon/ Attempted Boarding	119	122	24	9	2	0

Table of reported acts of piracy in the Indian Ocean from 2010 to 2015.
Source: U.S. Office of Naval Intelligence

5.7 Retirement of some Pacific TRITON Sites

In 2000 JAMSTEC assumed responsibility for 12 surface and 1 subsurface TAO sites between 137°E and 156°E, which established the TAO/TRITON array. At the same time, JAMSTEC established 4 additional TRITON moorings along 130° and 138°E. Beginning in 2012 some TRITON sites in the Pacific have been retired. At present 8 of the original TAO sites are active. Plans for 2015/2016 are to retire 6 of these. In addition to the remaining 2 sites, JAMSTEC will continue to maintain an ADCP mooring at 0°, 156°E (not a formal TAO/TRITON site) and will deploy a new TRITON mooring at 13°N, 138°E (north of TAO/TRITON).

5.8 TPOS2020

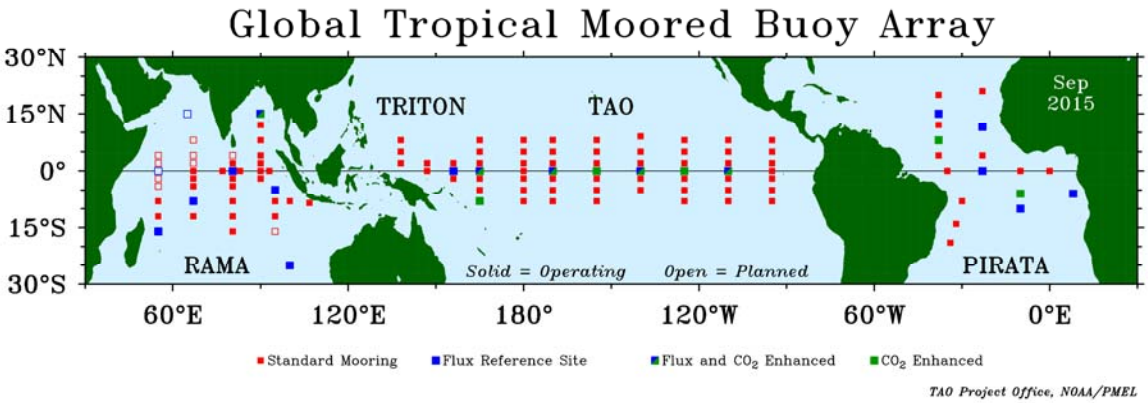
The Tropical Pacific Observing System 2020 (TPOS 2020) is an international project to refine the observing system in the tropical Pacific, which was designed in the 1980s based on 1980s science issues and largely on techniques from that era. TPOS 2020 goals include:

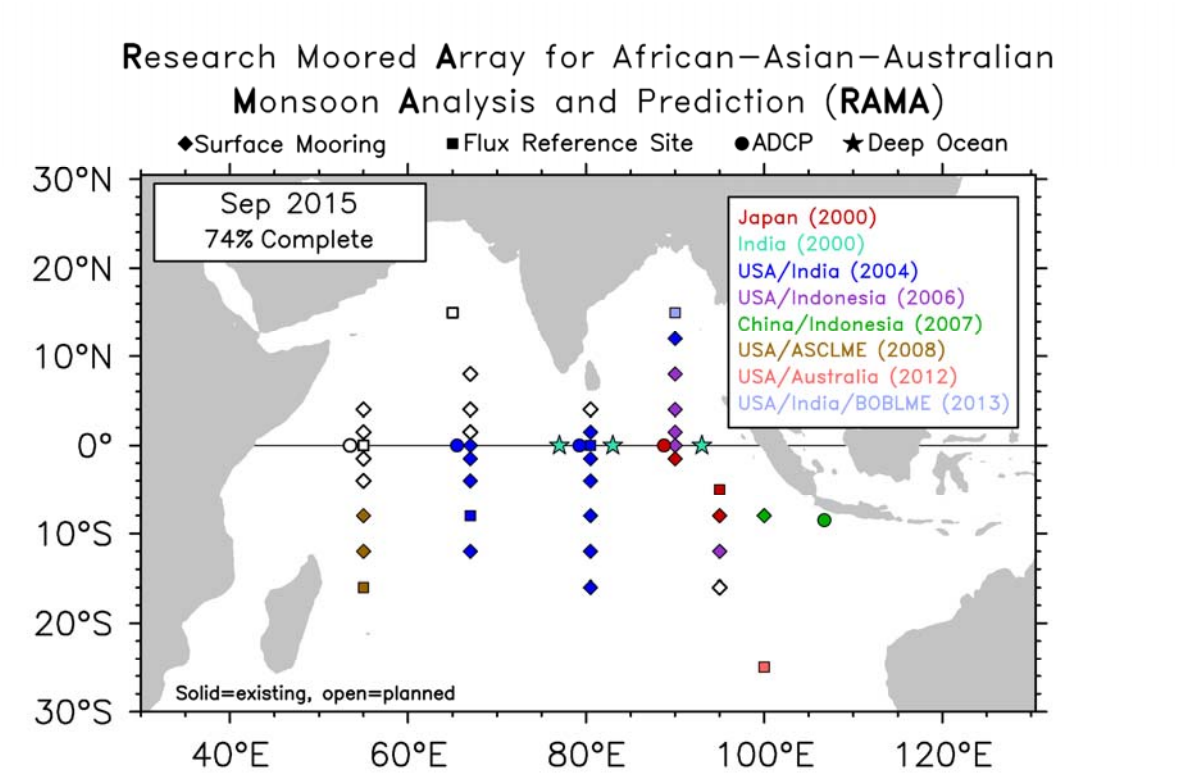
- To redesign and refine the TPOS to observe ENSO and advance understanding of its causes,
- To determine the most efficient and effective observational solutions to support prediction systems for ocean, weather and climate services,
- To advance understanding of tropical Pacific physical and biogeochemical variability and predictability.
- To provide evidence-based, vetted advice pointing to an intelligent evolution of the observing system

TPOS 2020 is an international project under GOOS, with a Steering Committee comprised of 15 members from 6 nations. Co-chairs are Billy Kessler (NOAA) and Neville Smith (former director of BOM, retired). Task Teams have been formed to focus on Planetary Boundary Layers, Models and data assimilation, Biogeochemistry, the Eastern and Western Pacific, and the Backbone (sustained basin-scale observations).

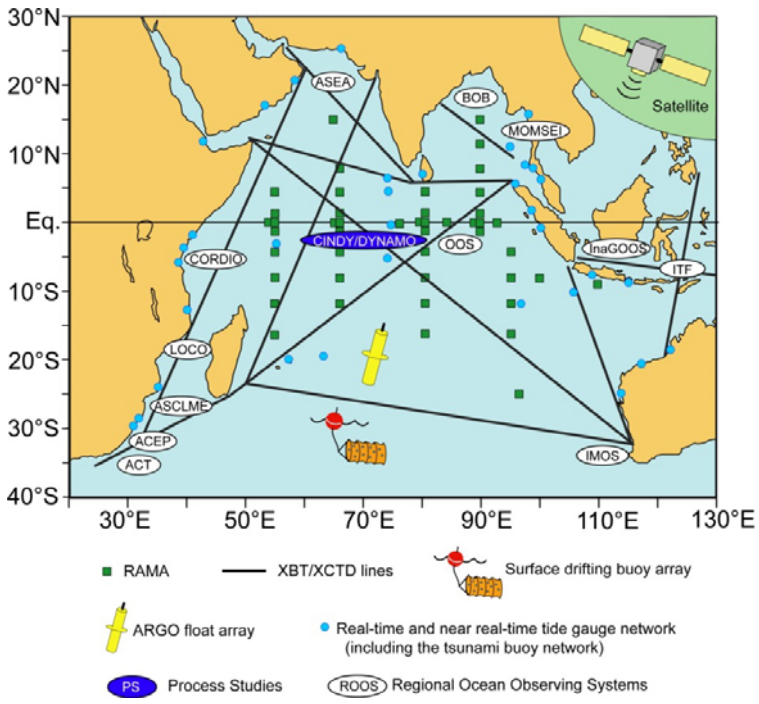
Annex

Status maps and graphics





Indian Ocean Observing System (IndOOS)



APPENDIX G

IABP
International Antarctic Buoys Programme

1) Summary

Name of Action Group	International Antarctic Buoys Programme (IABP)
Date of report	22 September 2015
Overview and main requirements addressed	Participants of the IABP continue to work together to maintain a network of drifting buoys on the ice of the Arctic Basin to provide meteorological and oceanographic data for real-time operational requirements and research purposes including support to the World Climate Research Programme (WCRP) and the World Weather Watch (WWW) Programme.
Area of interest	Central Arctic Ocean and its marginal seas, excepting Exclusive Economic Zones, where agreements of the Coastal States have not been obtained
Type of platform and variables measured	Buoys on ice and/or in water measuring: Basic meteorological variables such as atmospheric air pressure and air temperature. Other variables such as: atmospheric pressure tendency, air chemistry (e.g. ozone), snow and sea-ice properties, as well as sub-surface oceanographic characteristics (e.g. temperature and salinity)
Targeted horizontal resolution	250 km x 250 km
Chairperson/Managers	Chairperson: Christine Best, Meteorological Service Canada
Coordinator	Ignatius Rigor, Polar Science Center, University of Washington, USA
Participants	Participants range from Science Institutions to Universities to Government Agencies. http://iabp.apl.washington.edu/overview_participants.html Participant contributions are shown on this site http://iabp.apl.washington.edu/overview_contributions.html
Data centre(s)	
Website	http://iabp.apl.washington.edu/
Meetings *(meetings held in 2013/2014; and planned in 2014/2015)*	Annual meetings spring or early summer in the Northern Hemisphere. 25th Annual Meeting of the International Arctic Buoy Programme [IABP], hosted by the University of Washington, Seattle, Washington, USA on June 8 – 10, 2015. We are planning to have our next meeting to coincide with KOPRI's International Polar Science Symposium in May, 2016.
Current status summary *(mid-2015)*	162 buoys were reporting (Fig. 1).
Summary of plans for 2016	Summer is the primary deployment season in the Arctic. Participants will deploy 70+ buoys ranging from: SVP's providing surface air pressure, buoys providing air pressure and air temperature,

	Ice Mass Balance buoys, Oceanographic Profiling buoys measuring temperature and salinity to great depths and buoys that measure atmospheric air components such as ozone. Plans for future years will be similar.

2 Deployment plans for 2015

Deployment plans for 2016 will be posted on the IABP web page http://iabp.apl.washington.edu/overview_deploymentplans.html. As plans and opportunities for deployments become known, Participants are encouraged to contact the IABP Coordinator Ignatius Rigor Ignatius@uw.edu.

3 Data management

3.1 Distribution of the data

Most of the meteorological and oceanographic data is posted on the GTS. Much of the ice data and atmospheric chemistry data are available from Participants' web pages. Efforts continue to have those using Iridium communication to find means to post data to the GTS.

3.1.1 Data policy

Data exchange policies of the Participants for that data not getting onto the GTS has not been catalogued. However, most Participants have web sites that display data and/or graphs of the data.

3.1.2 Real-time data exchange

Details on percentage of data distributed on GTS.
Details on data timeliness (i.e. reception time at operational meteorological services minus observation time), including known problems, possible solutions, statistics, etc.

3.1.3 Delayed mode data exchange

Data are available from http://iabp.apl.washington.edu as well as ISDM. Data are also archived at the World Data Center for Glaciology (www.nsidc.org), the U.S. National Science Foundation's Cooperative Arctic Data and Information Service (www.AONCADIS.org).
Collection of and distribution of metadata is an ongoing task of the Coordinator. We plan to provide metadata through the IABP web server (iabp.apl.washington.edu), and produce netCDF data files containing the metadata information.

3.2 Data quality

Feedback is ad hoc. Data is suppressed when noted to be questionable. The IABP Coordinator participates in the buoy QC forums of the DBCP and JCOMM, and performs day-to-day QC of the data. More thorough QC of the data is performed during the analysis and production of the research data bases.

4) Instrument practices

We are currently in the midst of a sensor intercomparison for the various buoys/instruments that we use to observe polar meteorology and oceanography at the Arctic Observing Experiment (AOX) test site in Barrow, Alaska.

Data analyses procedures for the Arctic are documented in journal papers. As part of our efforts to collect and provide the metadata, details on instruments and other procedures will be provided through our web pages.

5) Other issues as needed

Our challenges remain the same, i.e. maintaining the network of buoys in an ocean of increasingly dynamic sea ice, and deploying buoys in the Eurasian Arctic.

Annex (optional)

Status maps and graphics

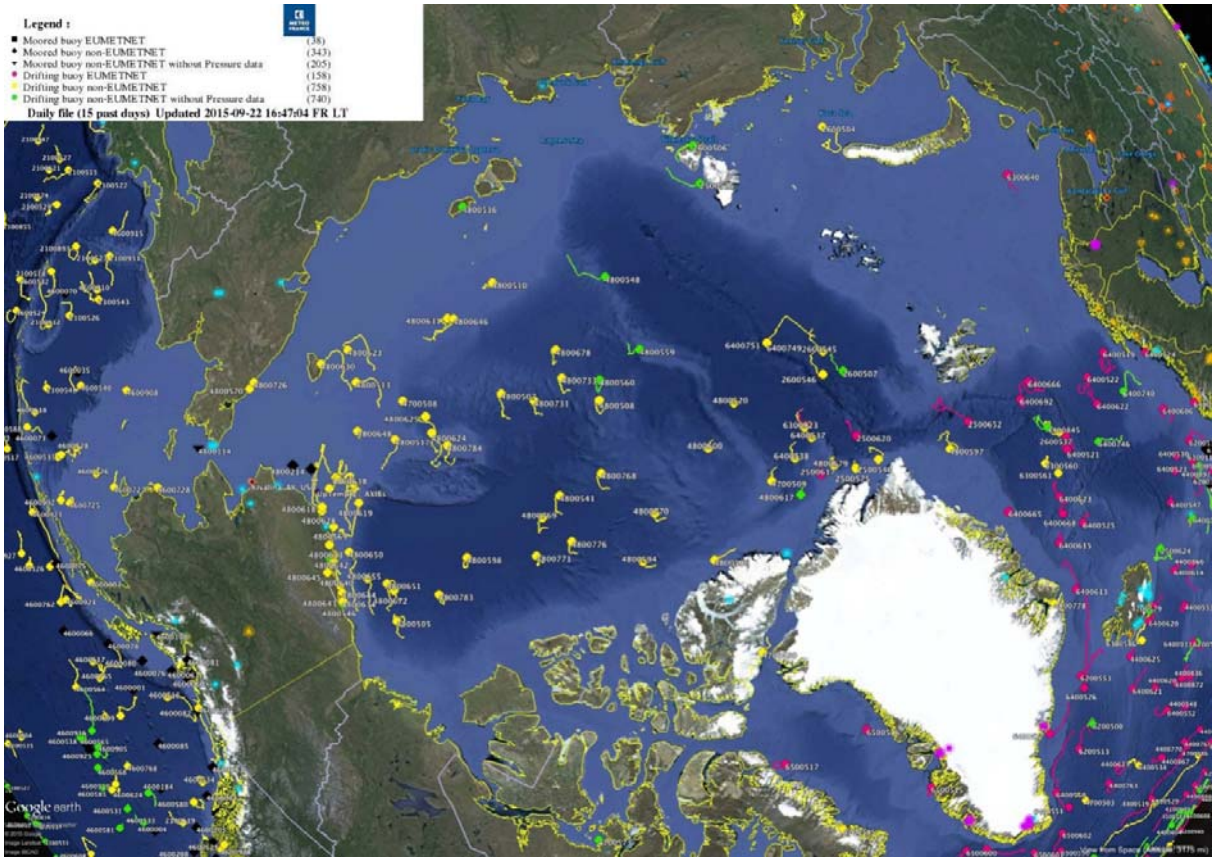


Figure 1. Map of buoy positions on 22 September 2016 from JCOMMOPS. 160 buoys were reporting. Many of these buoys were deployed in tight clusters in the Beaufort Sea north of Alaska.

APPENDIX H

IPAB
WCRP/SCAR International Programme for Antarctic Buoys

1) Summary

Name of Action Group	WCRP/SCAR International Programme for Antarctic Buoys (IPAB)
Date of report	20 Sep 2015
Overview and main requirements addressed	The Participants of the WCRP/SCAR International Programme for Antarctic Buoys (IPAB) work together to maintain a network of drifting buoys in the Southern Ocean, in particular over sea ice, to provide meteorological and oceanographic data for real-time operational requirements and research purposes. The IPAB was established in 1994 and became an Action Group of the Panel in October 1994.
Area of interest	South of 55°S and that region of the Southern Ocean and Antarctic marginal seas within the maximum seasonal sea-ice extent.
Type of platform and variables measured	Ice buoys measuring the following: Minimum variables: Buoy position Basic variables: Buoy position, atmospheric pressure and SST Other variables: Air temperature, ice and/or snow temperature, atmospheric pressure tendency, wind speed and direction, snow accumulation, other sea-ice properties and oceanographic variables
Targeted horizontal resolution	500 km x 500 km
Chairperson/Managers	Dr Petra Heil, AAD and ACE CRC, Hobart, Australia
Coordinator	Dr Christian Haas, York University, Toronto, Canada; Dr. Ignatius Rigor, University of Washington, Seattle, USA
Participants	- Alfred Wegener Institut, Germany - Australian Antarctic Division, Australia - Bureau of Meteorology, Australia - British Antarctic Survey, UK - Finnish Institute for Marine Research, Finland - GI, University of Alaska Fairbanks, USA - IARC, University of Alaska Fairbanks, USA - National Ice Center, USA - National Snow and Ice Data Center NSIDC, USA - ISDM/MEDS, Dept. of Fisheries and Ocean, Canada - Meteorological Service NZ LTD, New Zealand - Norwegian Polar Institute, Norway - Polar Science Center, Univ. of Washington, USA - National Institute of Polar Research, Japan - JAMSTEC, Japan - Programma Nazionale di Ricerche in Antartide, Italy - DAMTP, UK - SAMS, UK - York University, Toronto, Canada - CLS/Service Argos, France

	- South African Weather Service, South Africa- Meteorological Office, UK - CRREL, USA
Data centre(s)	Alfred Wegener Institute for Polar and Marine Research, Germany: http://www.pangaea.de/search?q=ipab National Snow and Ice Data Center NSIDC, USA: http://nsidc.org/data/docs/daac/nsidc0084_ipab_antarctic_buoys.gd.html
Website	http://www.ipab.aq/
Meetings *(meetings held in 2014/2015; and planned in 2015/2016)*	IPAB participants reported during the annual meeting of the International Arctic Buoy Programme IABP in Seattle, Washington, USA, on June 8-10, 2015. It has been considered to hold the next IPAB participants meeting together with the annual IABP meeting, possibly at the Koran Polar Research Institute KOPRI, in May or June 2016.
Current status summary *(mid-2015)*	1. 6 buoys were deployed during AWI Polarstern cruise PS89/02 in the Weddell Sea, including SVP, IMB, and snow buoys contributed by AWI. The Meteorological Services of South Africa, Australia, and New Zealand continue to operationally deploy numerous SVP's in the Southern Ocean, primarily north of the sea ice edge.
Summary of plans for 2015/16	Main deployments will be during a German icebreaker cruise to the Weddell Sea in Dec 2015/Jan 2016. It is planned to deploy 9 snow buoys, 9 SAMS IMBs, 10 SVPs (with contributions from AAD), and 2 Bio-Phys buoys.

2 Deployment plans for 2015/16

- AWI Polarstern cruise to Weddell Sea (PS96), Dec 2015 - Jan 2016; have plans to deploy 9 snow buoys, 9 SAMS IMBs, 10 SVPs (with contributions from AAD), and 2 Bio-Phys buoys.; invite additional contributions by other participants
- The Meteorological Services of South Africa, Australia, and New Zealand will continue to operationally deploy numerous SVP's in the Southern Ocean, primarily north of the sea ice edge.

3 Data management

3.1 Distribution of the data

3.1.1 Data policy

Data are generally freely distributed among IPAB participants as part of general scientific collaboration. Participants are encouraged to submit their data to the IPAB coordinator upon completion of their own scientific analyses.

3.1.2 Real-time data exchange

Participants are encouraged to transmit their data to the GTS. Most of the buoys deployed by the USIPAB program transmitted to the GTS. Other participants are overwhelmed by new requirements due to increased usage of Iridium transmission.

3.1.3 Delayed mode data exchange

We work closely with the Integrated Science Data Management Service (ISDM) of the Department of Fisheries and Ocean (DFO), Canada on the reception, archiving, and posting of IPAB GTS data.

3.2 Data quality

Data quality is an ongoing issue. QC is performed by the individual science groups, or by some national data centres and the DBCP when data are transmitted to the GTS.

4) Instrument practices

N/A

5) Other issues as needed

- GTS transmission of data remains a challenge; need to raise awareness of buoy operators
- Small number of buoys and short survival times remain important challenges, as does GTS transmission.
- Need boost for YOPP

_____

Annex

Status maps and graphics

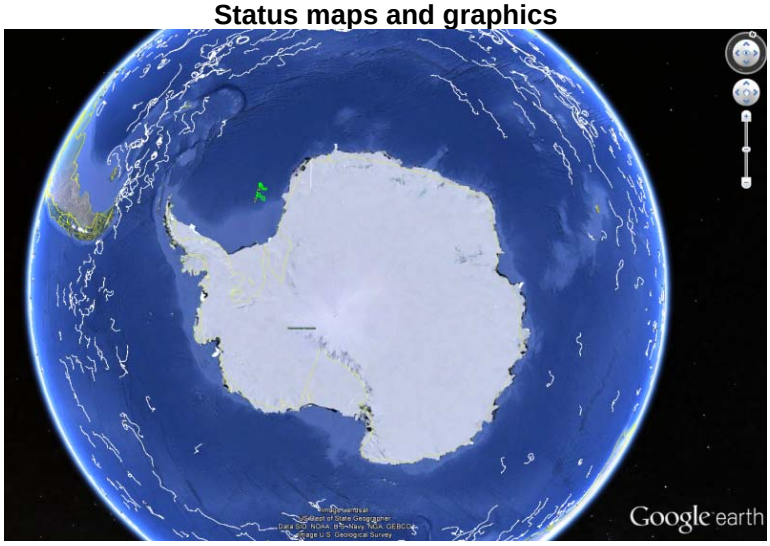


Figure 1: Status of Southern Ocean GTS buoy network, May 2015. Only 4 AWI buoys are visible (green). Downloaded from the Integrated Science Data Management Service (ISDM) of the Department of Fisheries and Ocean (DFO), Canada (http://isdm.gc.ca/isdm-gdsi/drib-bder/KML/MonthlyKML-eng.htm)

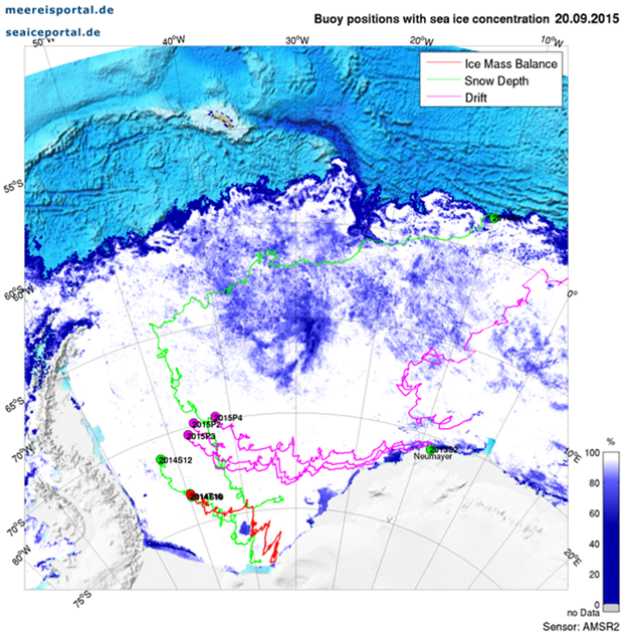


Figure 2: Drift tracks of buoys still active in September 2015 in the Weddell Sea, deployed during Polarstern cruises in 2014 and 2014/15. Map from meereisportal.de

APPENDIX I

GDP
GLOBAL DRIFTER PROGRAMME

1) Summary

Name of Action Group	Global Drifter Program
Date of report	15 September 2015
Overview and main requirements addressed	Global Drifter Program (GPD). Goals: 1. Maintain a global 5x5° array of 1250 satellite-tracked surface drifting buoys to meet the need for an accurate and globally dense set of in-situ observations of mixed layer currents, sea surface temperature, atmospheric pressure, winds and salinity; and 2. Provide a data processing system for scientific use of these data. These data support short-term (seasonal to interannual) climate predictions as well as climate research and monitoring.
Area of interest	Global ocean
Type of platform and variables measured	Lagrangian drifters measuring surface velocity, SST; some drifters also measure sea level pressure, wind, salinity, and/or sub-surface temperature profiles
Targeted horizontal resolution	5 degree x 5 degree (1250 units)
Chairperson/Managers	Dr Rick Lumpkin, NOAA/AOML, USA Dr Luca Centurioni, SIO/CIMEC, USA
Coordinator	Operations Manager: Mr Shaun Dolk, NOAA/AOML, USA
Participants	Numerous national and international institutions
Data centre(s)	GDP Data Assembly Center (DAC) – Manager: Ms Mayra Pazos, NOAA/AOML, USA
Website	http://www.aoml.noaa.gov/phod/dac/
Meetings *(meetings held in 2014/2015; and planned in 2015/2016)*	None other than DBCP
Current status summary *(mid-2015)*	Annual size of array was 1389 drifters. Current size as of 14 September 2015 is 1468 drifters.
Summary of plans for 2015	Maintain array at ~1250 drifters or more

2 Deployment plans for 2015-2016

Deployments in the period 14 September 2014 through 13 September 2015 are shown in Fig. 1. A total of 1117 drifters were deployed during this period, compared to 1660 drifters last year (when the array had fallen below 1250 drifters and needed to be replenished). The array began this period at 1395 drifters.

In the coming year, the GDP Deployment Plan is:

Operational Buoy Deployments	800
Consortium Research Buoy Deployments	200
Total Deployments in 2013-2014	1000

More deployments may be needed to fill gaps in the global array as they develop, and will be conducted if more drifters are available for deployment.

In addition to the regular deployment opportunities provided by vessels of opportunity and regularly occurring research cruises, notable deployments planned for August 2015-July 2016 include:

- ~ 80 SVP drifter deployments in the equatorial Pacific, during TAO mooring cruises (~ 10 deployments per line)
- 20-25 SVPB drifter deployments in the N. Pacific, during the annual DART cruise
- 30 SVPB drifter deployments in the S. Pacific from the R/V *Araon*
- ~40 SVPB drifter deployments in the Indian Ocean, during RAMA mooring cruises
- 10 SVPB drifter deployments in the Indian and Pacific Oceans from the R/V *Kaharoa*
- 10 SVP drifter deployments in the tropical Atlantic Ocean from the MV *Explorer*
- 20 SVP drifter deployments in the equatorial Pacific from the MV *Explorer*
- 10 SVPB drifter deployments in the Indian Ocean from the MV *Explorer*
- ~50 SVP drifter deployments in the Pacific Ocean by the US Coast Guard
- 40 SVPB drifter deployments in the Drake Passage
- 20 SVPB drifter deployments in the SE Pacific Ocean by new GDP partners at the University of Valparaiso
- ~30 SVP drifter deployments in the equatorial Pacific by GDP partners in Peru, Columbia, Chile, and Ecuador
- ~20 SVP drifter deployments in the Pacific Ocean during the Blue Planet Odyssey sailing event

3 Data management

3.1 Distribution of the data

The drifter Data Assembly Center (DAC) assembles, quality controls and interpolates data from approximately 1300 drifters per month from all GDP national and international partners, from all oceans of the world. These data are made available through the web with a delayed time of 3—4 months. As of the time of writing this report (mid-September 2015),quality-controlled data are available through June 2015. These data can be accessed at http://www.aoml.noaa.gov/phod/dac/dacdata.php.

3.1.1 Data policy

The DAC, located at NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) has access to drifters from GDP partners that have given Service Argos permission to make these data available to the DAC. In return the partners have access to all quality controlled and interpolated data available in the database via the World Wide Web. Non-interpolated quality controlled data and raw data are made available via ftp transfer upon request.

3.1.2 Real-time data exchange

All data from drifters in the GDP's programs are disseminated via GTS as soon as drifters are deployed. The GDP monitors data going out on the GTS, and transmissions of sensors producing bad data or transmissions from grounded drifters are removed from the GTS data stream.

As of 14 September 2015, there were 1468 GDP drifters transmitting good quality data on the GTS. Other GDP partners are expected to distribute their drifter data on the GTS as soon as deployments have occurred. The GDP does not monitor GTS data timeliness and relies on operational centres to report on these issues.

3.1.3 Delayed mode data exchange

Drifter data (raw data, edited non-interpolated and interpolated data) are archived at AOML. The quality controlled data bases are currently available through June 2015. These datasets are also sent to Integrated Science Data Management (ISDM), the RNODC for drifter data, for permanent archival and further distribution. The DAC has recently identified some issues with the ISDM archive and is actively working with the manager of that archived to rectify these issues.

Metadata for GDP drifters are received at the DAC directly from drifter manufacturers who send standardized specification sheets for batches of identical drifters prior of delivery of the instruments. Portions of this metadata are extracted and are made available on the deployment log at the DAC web page www.aoml.noaa.gov/phod/dacdeployed.html. Specification sheets are archived at the DAC. Deployment date, date of last transmission, drogue off and cause of death metadata are determined during quality control of the dataset and are made available through the web at www.aoml.noaa.gov/phod/dac/dirall.html. These web pages are interrogated by JCOMMOPS to gather information for their metadata systems.

3.2 Data quality

The DAC is implementing drogue detection procedures for drifters with GPS using Time To First Fix and GPS fix quality, as recommended in DBCP-30.

4) Instrument practices

Technical supervision and developments related to the design of the SVP drifter are led by the Scripps component of the GDP. These developments aim to standardize and improve the drifter design. In previous years, this has included:

- Ruggedized tether attachment for strength and water infiltration implemented across the drifter fleet;
- Recommendation for high quality batteries issued to manufacturers and implemented;
- Design of ruggedized battery packs;
- Recommendation for more accurate SST (0.05°C) issued to manufacturers and implemented by SIO;
- Recommendation for ruggedized drogue design issued to manufacturers and implemented;
- New tether material (synthetic rope) is currently under evaluation.

The following tables summarize deployments, deaths, etc. for drifters by year and by manufacturer, calculated through the end of December 2014. Half-lives are reported as a function of the deployment year of a drifter (e.g. the half-life for 2012 is for all drifters deployed in 2012). The appearance of "*" indicates that there were not enough values to make the calculation. A half-life of ">X" is a minimum estimate, indicating that more than half are still alive or still have drogues attached; the final value will be larger. In this table, salinity drifters and wind drifters have not been included. Note that "quit" drifters are drifters which are believed not to have been picked up or ran aground, and also excludes all drifters that died poleward of 55 degrees latitude. In other words, "quit" drifters are those likely to have died from internal reasons such as battery failure.

NUMBER OF DEPLOYMENTS

Manufacturer	2007	2008	2009	2010	2011	2012	2013	2014
Clearwater	469	390	355	445	260	409	168	75
DBi	0	0	0	0	4	158	280	273
Marlin-Yug	6	17	24	10	0	7	0	7
Metocean	220	143	216	199	220	153	100	164
Pacific Gyre	113	270	264	231	357	199	280	383
SIO	0	0	0	0	0	103	256	210
Technocean	274	175	279	394	252	29	21	34

NUMBER OF DEATHS

Manufacturer	2007	2008	2009	2010	2011	2012	2013	2014
Clearwater	543	487	391	458	362	337	266	113
DBi	0	0	0	0	1	52	172	151
Marlin-Yug	1	14	24	7	7	4	4	7
Metocean	110	186	150	233	259	201	82	146
Pacific Gyre	99	193	206	225	271	385	225	264
SIO	0	0	0	0	0	49	173	176
Technocean	278	269	259	345	434	226	104	47

PERCENT QUIT

Manufacturer	2007	2008	2009	2010	2011	2012	2013	2014
Clearwater	63%	78%	67%	71%	95%	59%	123%	124%
DBi	*	*	*	*	25%	15%	31%	22%
Marlin-Yug	17%	18%	8%	30%	*	43%	*	86%
Metocean	30%	87%	37%	67%	70%	80%	54%	50%
Pacific Gyre	53%	37%	43%	61%	51%	134%	56%	31%
SIO	*	*	*	*	*	20%	29%	21%
Technocean	39%	69%	43%	45%	115%	621%	410%	71%

HALF-LIFE (DAYS)

Manufacturer	2007	2008	2009	2010	2011	2012	2013	2014
All drifters:								
Clearwater	206	253	217	163	139	192	356	>385
DBi	*	*	*	*	364	259	419	>359
Marlin-Yug	577	78	162	485	*	483	*	>233
Metocean	370	396	384	211	189	150	285	189
Pacific Gyre	212	231	284	284	208	190	358	>298
SIO	*	*	*	*	*	137	158	196
Technocean	522	497	476	262	148	53	0	19
"Quit" drifters:								
Clearwater	251	217	213	160	155	199	406	>388
DBi	*	*	*	*	364	298	>605	>475
Marlin-Yug	635	856	634	963	*	>861	*	>233
Metocean	402	456	445	274	221	181	337	>272
Pacific Gyre	262	598	336	345	235	227	471	>450
SIO	*	*	*	*	*	201	503	>438
Technocean	673	959	642	280	190	53	0	32

PERCENT LIVED <90 DAYS

Manufacturer	2007	2008	2009	2010	2011	2012	2013	2014
Clearwater	7%	11%	11%	26%	28%	12%	13%	14%
DBi	*	*	*	*	25%	9%	6%	4%
Marlin-Yug	0%	6%	0%	10%	*	14%	*	29%
Metocean	7%	5%	6%	5%	11%	18%	11%	15%
Pacific Gyre	12%	12%	17%	4%	5%	7%	4%	5%
SIO	*	*	*	*	*	5%	8%	8%
Technocean	9%	8%	4%	11%	32%	55%	90%	32%

DROGUE HALF-LIFE (DAYS)

Manufacturer	2007	2008	2009	2010	2011	2012	2013	2014
Clearwater	72	101	104	95	84	>293	>452	>387
DBi	*	*	*	*	279	227	244	>232
Marlin-Yug	152	72	57	167	*	0	*	20
Metocean	>373	269	224	77	89	110	211	>227
Pacific Gyre	210	206	241	248	207	>228	241	>219
SIO	*	*	*	*	*	66	>142	>137
Technocean	45	33	63	74	154	>62	0	>14

PERCENT THAT HAD DROGUE OFF <90 DAYS

Manufacturer	2007	2008	2009	2010	2011	2012	2013	2014
Clearwater	55%	36%	30%	36%	39%	14%	4%	14%
DBi	*	*	*	*	25%	11%	12%	7%
Marlin-Yug	0%	41%	46%	40%	*	43%	*	71%
Metocean	13%	17%	26%	40%	45%	35%	14%	21%
Pacific Gyre	20%	21%	17%	10%	16%	21%	9%	16%
SIO	*	*	*	*	*	40%	23%	13%
Technocean	65%	78%	53%	46%	27%	31%	29%	44%

PERCENT THAT HAD DROGUE OFF <10 DAYS

Manufacturer	2007	2008	2009	2010	2011	2012	2013	2014
Clearwater	7%	4%	7%	7%	5%	3%	2%	3%
DBi	*	*	*	*	0%	4%	3%	0%
Marlin-Yug	0%	24%	33%	10%	*	43%	*	43%
Metocean	8%	13%	6%	12%	6%	8%	4%	4%
Pacific Gyre	8%	11%	8%	2%	4%	7%	0%	1%
SIO	*	*	*	*	*	24%	1%	0%
Technocean	10%	11%	10%	9%	3%	14%	14%	29%

In order to evaluate the value of single vs. double battery packs on the lifetimes of drifters, the half-lives of all DBi and SIO drifters were evaluated for the period 2012—2014. Only these two manufacturers had a significant number of double pack drifters according to the DAC metadata. All, rather than “quit”, drifters were evaluated to test the operational value of doubling the battery pack (i.e., including deaths due to running aground, being picked up, etc.) Single battery pack drifters were identified as those drifters with starting amp hours of 56—57, while double pack drifters were those starting at 112. The results (see below) are most robust for 2013, when a large number of double battery pack drifters were deployed. They suggest that the mean half life is increased by a factor of ~1.5 when the number of batteries is doubled.

NUMBER OF DEPLOYMENTS (single/double battery packs)

Manufacturer	2012	2013	2014
DBi	156/2	235/45	209/64
SIO	2/14	177/31	209/1

NUMBER OF DEATHS

Manufacturer	2012	2013	2014
DBi	51/1	168/4	125/26
SIO	1/0	69/29	153/11

HALF-LIFE (DAYS)

Manufacturer	2012	2013	2014
DBi	259/393	345/>699	>354/>386
SIO	58/279	157/224	195/>386

PERCENT LIVED <90 DAYS

Manufacturer	2012	2013	2014
DBi	9%/50%	7%/4%	4%/5%
SIO	0%/0%	6%/13%	8%/0%

5) Evolution of the Global Drifter array

The growth of the array through 14 September 2015 is shown in Fig. 2. During the last year, the array had an average size of 1389 drifters. This period began with the array at 1395 drifters and concluded with the array at 1468 drifters.

Annex (optional)

Status maps and graphics

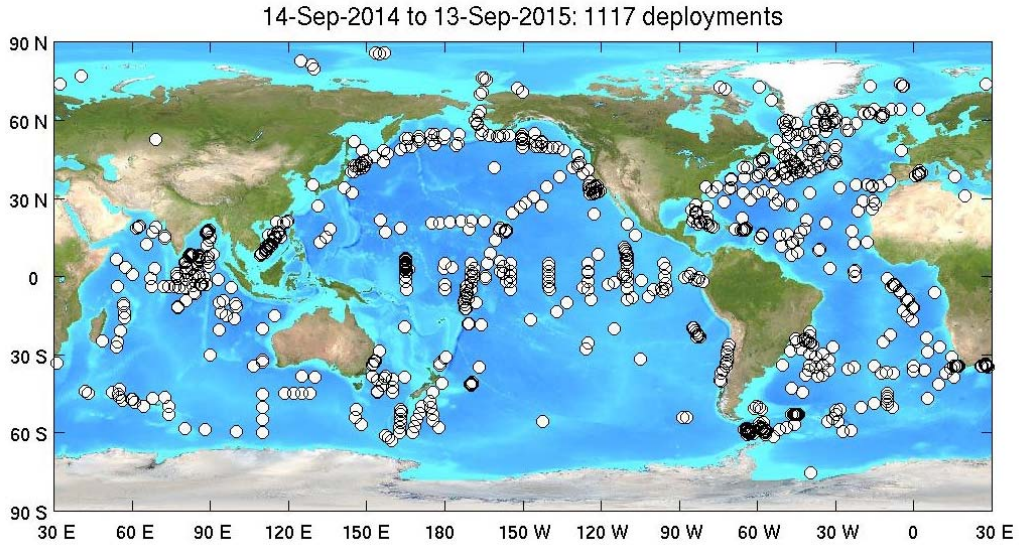


Fig. 1: Global Drifter Program deployment locations during the year.

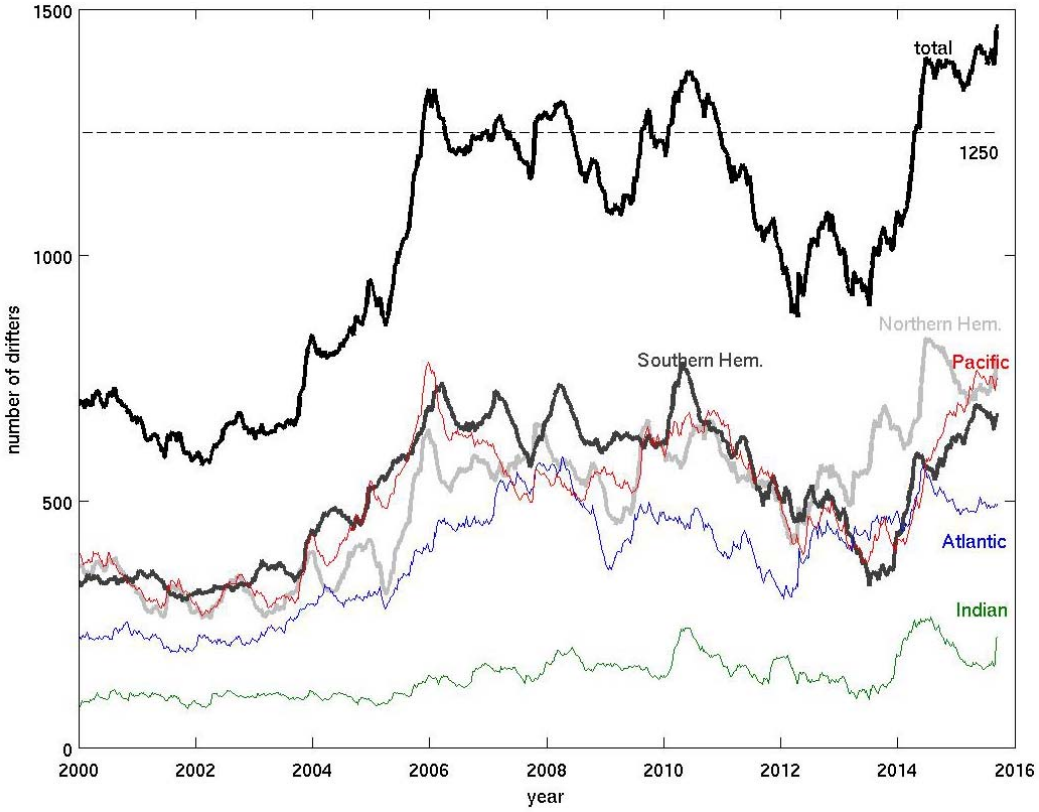


Fig. 2: Size of global drifter array, total (black) and in various subregions (color). Atlantic/Indian divided at 25°E in the Southern Ocean, Atlantic/Pacific at 70°W in the Southern Ocean, Indian/Pacific at 125°E south of Timor.

APPENDIX J

OCEANSITES
OCEAN SUSTAINED INTERDISCIPLINARY TIME-SERIES ENVIRONMENT OBSERVATION SYSTEM

1) Summary

Name of Action Group	OceanSITES
Date of report	01 October 2015
Overview and main requirements addressed	OceanSITES is a worldwide system of long-term, deepwater Ocean time series stations measuring multidisciplinary variables with an emphasis on resolving higher frequencies and with good vertical resolution. Across the whole array, observations cover from air-sea interactions down to the sea floor. Data is shared openly via two Global Data Assembly Centers.
Area of interest	Global
Type of platform and variables measured	Most of the sites are occupied by moorings, either surface or subsurface. Many sites make the basic physical measurements (pressure, temperature, conductivity, and velocity). Some sites includes optical, biological, and chemical sensors.
Targeted horizontal resolution	On the global scale, a sparse array occupying key and representative sites covering the global ocean. At select sites, arrays for the purpose of observing transport or regional processes (e.g., the equatorial moored arrays).
Chairperson/Managers	Uwe Send, SIO Bob Weller, WHOI
Coordinator	Champika Gallage Project Office
Participants	Executive Committee, Steering Team Members, and Data Management Team Members
Data centre(s)	2 Global Data Assembly Centers IFREMER Coriolis (FTP). ftp://ftp.ifremer.fr/ifremer/oceansites/ US NDBC (FTP). ftp://data.ndbc.noaa.gov/data/oceansites
Website	www.oceansites.org
Meetings *(meetings held in 2014/2015; and planned in 2015/2016)*	**2014** 10th Steering Committee and 7th Data Management Team Meetings in Recife, Brazil Nov 3-6, 2014 11th Steering Committee and 8th Data Management Team Meetings planned for Southhampton, U.K., April 2016 http://www.oceansites.org/meetings/index.html
Current status summary *(August-2015)*	The OceanSITES Network consists of over 200 reference sites in the deep-ocean plus an additional 94 standard meteorological sites (TAO, RAMA, PIRATA). One of the goals of OceanSITES is to have data freely available, in real-time if possible. Currently there are 82 sites transmitting data in real-time to a local or regional data centre (Figure 1). OceanSITES has an active Data Management team that works with site PIs to share data in a common NetCDF format. The format specifications have been developed by the DMT in collaboration with the Steering Committee and Exec Board. Currently only around 34% of

	these sites are submitting data to one of the Global Data Assembly Centers (GDAC) in this format (Figure 2). At the 2011 La Jolla OceanSITES meeting, it was decided to make use of the many existing OceanSITES platforms in deep water to make an "instant" contribution towards the gap in deep-ocean observations as identified at OceanObs09. OceanSITES at over 50 sites around the world already carry deep temperature/salinity (T/S) sensors. OceanSITES members had a goal to deploy another 50, which requires 50 sensors for the initial deployments and another 50 for swapping out and calibrations (Figure 3). OceanSITES PIs have pledged to add such sensors to their existing moorings and as of August 2015 26 sensors were installed with an additional 10 are planned in the coming year(s). In addition to the sensor contribution by PIs, OceanSITES has a pool of matching sensor for the swap-outs via donations from institutions, agencies and companies. The community has nearly 50 instruments in the “pool” for exchanging and adding to sites around the world thanks to a number of generous donations. In 2015 OceanSITES Steering Committee has developed number of documents to organise the community; • Mission Statement • Benefits of joining OceanSITES • Charter (Governance Document) • How to become an OceanSITES • What is OceanSITES • Goals and Objectives • OceanSITES data providers Guide Two of the documents “ Mission Statement and the “Benefits of Joining OceanSITES” are finalized and posted on the OceanSITES website. Rest of the documents are in the process of finalizing and will be available on the website in near future. In 2015, the OceanSITES Data Management Team reviewed the Data Format Reference Manual (formerly User’s Guide). The new Reference Manual is now published on the website and the community is encouraged to follow the new guide when preparing their data. The OceanSITES Data Management Team welcomed a new Chair Derrick Snowden, of NOAA/US Integrated Ocean Observing System. Mr. Snowden has stepped in to replace the departure of the previous chair Julie Thomas. The DMT welcomed Mr. Snowden and his leadership. The DMT then continued to hold regular monthly meetings via Webex. The OceanSITES Executive Committee set regular meeting times at once a month and held these throughout the year. In December 2015 OceanSITES will be the subject of a GOOS Webinar.
Summary of plans for 2016	In April 2016 OceanSITES 11th Steering Committee and 8th Data Management Team Meetings in Southampton UK.

	The OceanSITES Executive Committee will continue to meet regularly as will the Data Management Team. Executive Committee is working on finalizing several documents 1)What is OceanSITES and 2) Goals and Objectives. Executive Committee will also develop the performance Indicators for the OceanSITES during 2016. Formalization of the processes and procedures for managing the deep ocean temperature/salinity program, and establishment of the next set of sites to be instrumented. Increase data holdings at the OceanSITES GDACs. Increase the involvement of FixO3 members in OceanSITES program

2 Deployment plans for 2015

There are 22 planned sites to be included in the OceanSITES network (Figure1).

3 Data management

3.1 Distribution of the data

3.1.1 Data policy

The data flow within OceanSITES continues to be carried out through three organizational units: PIs, DACs, and the GDACs. The Principal Investigator (PI), typically a scientist at a research institution, maintains the observing platform and the sensors that deliver the data. He or she is responsible for providing the data and all auxiliary information to a Data Assembly Center (DAC). The DAC assembles OceanSITES-compliant files from this information and delivers these to the two Global Data Assembly Centers (GDACs), where they are made publicly available. The GDAC distributes the best copy of the data files. When a higher quality data file (e.g. calibrated data) is available, it replaces the previous version of the data file. The user can access the data at either GDAC, cf. section “GDAC organization”. Archive of preliminary or real-time data is currently under discussion with NOAA’s National Oceanographic Data Center and World Data Center (NODC- WDC) for Oceanography.

3.1.2 Real-time data exchange

Approximately 45% of the OceanSITES array is exchanging data in real-time.

3.1.3 Delayed mode data exchange

A requirement of all OceanSITES members is exchange of data free and openly. The goal is to make all data available in the standard OceanSITES NetCDF format on one of the 2 GDAC centers. At present around 34% of the members are providing data in this format and we hope to see this number increase. In 2014, we did see new sites added to the GDAC distribution. Many OceanSITES members are distributing data in other formats from sites in their own institution and do not have adequate resources to format the data into the proper format. The DMT and the GDACs are working with these members.

3.2 Data quality

OceanSITES data are partially transmitted in real-time and relayed to regional or national Data Assembly Centers (DACs). The DACS are responsible for applying automated real-time quality control tests to identify and flag grossly bad data. Data that pass the automated QC tests are broadcast on the GTS, apart from those purposely withheld for validation purposes. All data, with flags, are relayed to Global Data Assembly Centers (GDACs) in Brest, France, and at NDBC/USA. The GDACs maintain complete (mirror) datasets, and make all data available from one place in a unified format, initially via ftp directories, later through user-friendly interfaces.

4) Instrument practices

OceanSITES does not have a set of instrument handling standards and best practices of its own, but OceanSITES has an expectation that the PI-provided data have been collected according to such community-approved standards.

OceanSITES provides the following capabilities to this effect:

- OceanSITES science meetings serve as discussion forums where PIs can (and have done in the past) discuss such standards and practices.
- The OceanSITES data format requires the data provider to quantify uncertainty in the metadata, with optional information on instrument accuracy and precision.

- The OceanSITES data format provides a metadata field that can hold optional calibration information.
- The OceanSITES data format provides metadata fields that link to external documentation, meant among other things for documentation of instrument handling and practices, as well as institutional websites and science publications.
- OceanSITES efforts would benefit from a community-supported set of documents on instrument handling and best practices, a vision for which would be:
    - One document per instrument type and method
    - Each document citable e.g. via DOI
    - Documents to be under version control

5) Other issues as needed

None

Annex I

Status maps and graphics

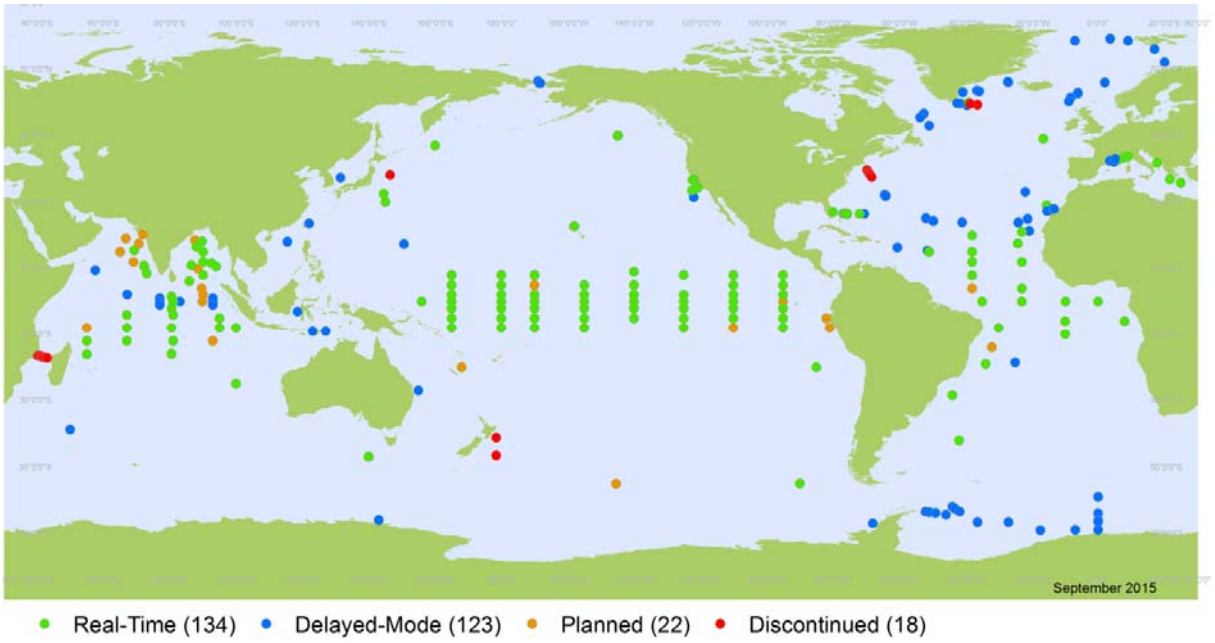


Figure 1 - Current status of the OceanSITES network (September 2014)

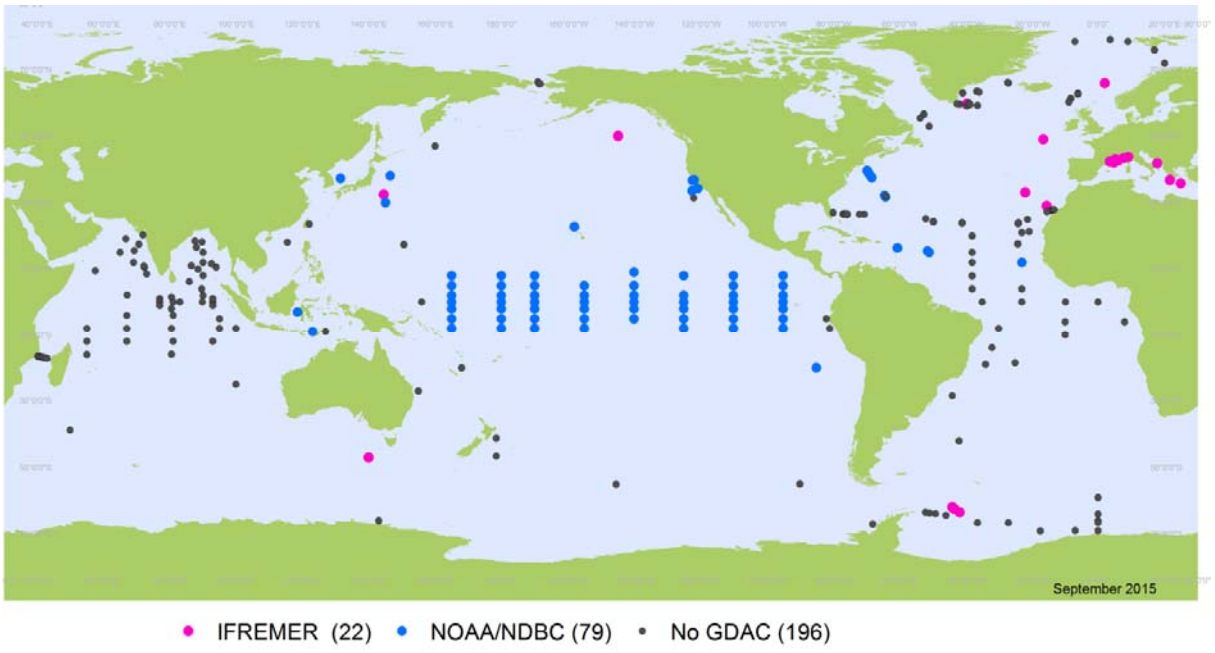


Figure 2 - OceanSITES submitting data to one of the GDACs.

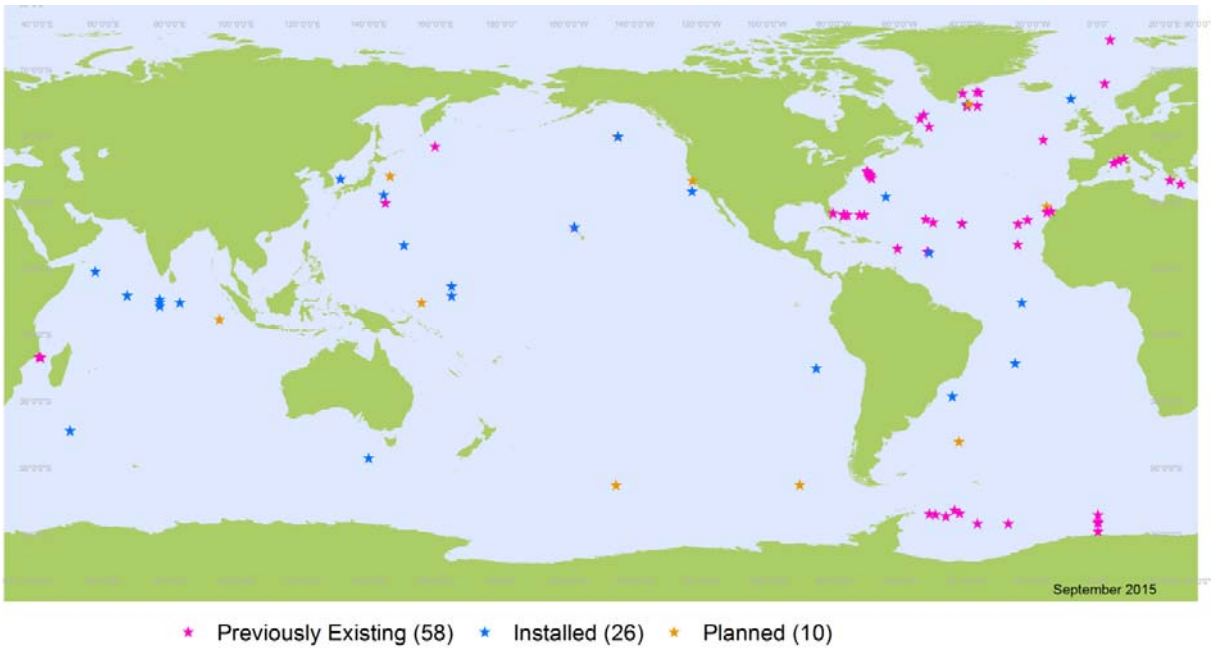


Figure 3 - Status of the deep-ocean temperature and salinity sensors