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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

DATA BUOY COOPERATION PANEL

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ITEM: 7

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REPORTS BY THE DBCP ACTION GROUPS 2013

(Submitted by the Action Groups)

Summary and purpose of the document

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

ACTION PROPOSED

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

Appendices:

-A- 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.

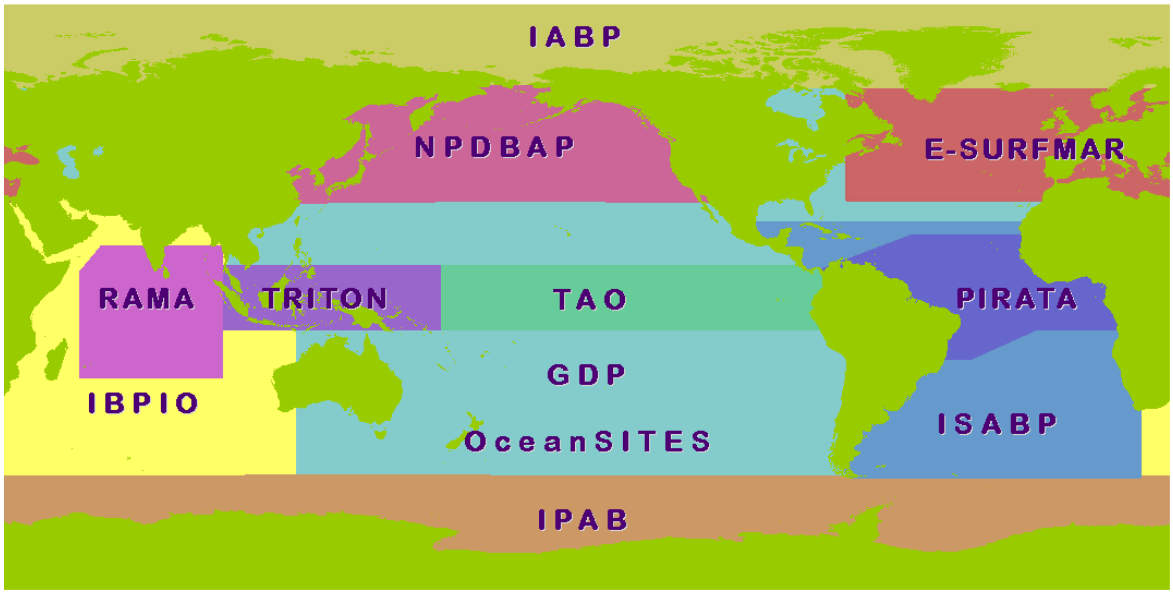


Figure 1: The regional extent of several of the DBCP Action Groups.

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 Ariel Toisi (Argentina), 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, Ms Kelly Stroker, representing OceanSITES project office);
(ix) **TIP:** Tropical Moored Buoys Implementation Panel (verbal presentation by Mr Chris Meinig on behalf of the TIP);
(x) **ITP:** International Tsunameter Partnership (verbal presentation by Mr Richard Crout (USA) representing the ITP).

7.2 Summaries of the presentations are reproduced in Appendices A to J. The full reports of the action groups will be reproduced in the Panel's Annual Report.

Appendices: 10

APPENDIX A

REPORT BY THE GLOBAL DRIFTER PROGRAMME (GDP)

(Report submitted by Rick Lumpkin, NOAA/AOML, USA)

1) Summary

Name of Action Group	**Global Drifter Program** **GDP**
Date of report	15 August 2013
Overview and main requirements addressed	Global Drifter Program (GDP). 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 2012/2013; and planned in 2013/2014)*	None other than DBCP.
Current status summary *(mid-2013)*	Annual size of array was 994 drifters. Current size as of 5 August 2013 is 1013 drifters.
Summary of plans for 2014	Restore array to ~1250 drifters; begin incorporating salinity data into data stream.

2 Deployment plans for 2014

Deployments in the period 5 August 2012 through 5 August 2013 are shown in Fig. 1. A total of 1472 drifters were deployed during this period. Some outstanding deployments include:

- 20 SVPBs in the West Indian Ocean (PI Helen Philips)
- 20 SVPBs in the North Indian Ocean (RAMA servicing in conjunction with PMEL and NIO)
- 20 SVPs in the North Atlantic (deployed during CLIVAR cruise)

- 20 SVPBs in the North Pacific (deployed during annual DART array servicing)
- 26 SVPs in the Tropical Atlantic (SPURS)
- 80 SVPGSs in the Tropical Atlantic (SPURS)
- 05 SVPBSs in the Tropical Atlantic (SPURS)
- 18 SVPs in the Equatorial Pacific (deployed by JAMSTEC collaborators)
- 12 SVPBs in the Indian Ocean (deployed by Indonesian collaborators)
- 15 SVPBs in the East Indian Ocean (RAMA servicing in conjunction with PMEL)
- 25 SVPs in the Equatorial Pacific (deployed by Ecuadorian, Peruvian, and Columbian collaborators)
- 24 SVPBs in the Drake Passage (PD Christian Reiss)
- 14 SVPs in the Gulf of Guinea (deployed by R/V Lady Amber)

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 will be needed to return the array to its goal size of 1250 drifters, and will be conducted if more drifters are available for deployment.

Regional deployment opportunities planned for 2013-2014 will include:

- 28 SVPBs in the Drake Passage (PI Christian Reiss)
- 30 SVPBs in the South Pacific (deployed by KIOST collaborators)
- 10 SVPBs in the North Indian Ocean (deployed by Australian Navy)
- 20 SVPBs in the North Pacific (deployed during annual DART array servicing)
- 20 SVPs in the Tropical Atlantic (deployed during annual PIRATA NEE cruise)
- 20 SVPBs in the North Indian Ocean (deployed during IX12)
- 30 SVPBs in the Southern Oceans (deployed during Barcelona World Race)
- 25 SVPs in the Equatorial Pacific (deployed during STRATUS cruise)

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 2013),quality-controlled data are available through December 2012. 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 5 August 2013, there were 1013 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 Argos data, edited non-interpolated and interpolated data) are archived at AOML. The quality controlled data bases are currently available through December 2012, and an update for the period January—June 2013 is planned for release by early September 2013. These datasets are also sent to Integrated Science Data Management (ISDM), the RNODC for drifter data, for permanent archival and further distribution. The DAC sent all data covering 2011 to ISDM; a new data set covering January to December 2012 will be sent shortly.

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.

The DAC is developing tools to quality control Iridium drifter data and include it in the database. Iridium data is current received weekly from Meteo-France via FTP.

3.2 Data quality

Methodology and results from an automatic drogue presence reassessment was published in the *Journal of Atmospheric and Oceanic Technology* (Lumpkin, R., S. Grodsky, M.-H. Rio, L. Centurioni, J. Carton and D. Lee, 2013: Removing spurious low-frequency variability in surface drifter velocities*. J. Atmos. Oceanic Techn*., **30** (2), 353—360, doi:10.1175/JTECH-D-12-00139.1). This article also described the criteria used for a full manual reevalution of drogue presence completed by the drifter DAC.

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 the previous year, 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 completed and currently under evaluation;
- 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;
- SIO completed SVP and SVPB drifter design and started production;

- 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 2012. 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.

NUMBER OF DEPLOYMENTS

Manufacturer	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Clearwater	430	469	390	355	445	259	409
DBi	0	0	0	0	0	4	158
Marlin-Yug	5	6	17	24	11	0	7
Metocean	67	219	143	216	199	219	146
Pacific Gyre	110	113	270	264	231	357	161
SIO	0	0	0	0	0	0	103
Technocean	286	274	175	279	394	252	29

NUMBER OF DEATHS

Manufacturer	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Clearwater	376	543	487	391	458	361	339
DBi	0	0	0	0	0	1	52
Marlin-Yug	0	1	14	24	8	7	4
Metocean	59	104	186	150	233	258	200
Pacific Gyre	163	99	193	206	225	272	384
SIO	0	0	0	0	0	0	48
Technocean	358	278	268	260	345	434	226

HALF-LIFE (DAYS)

Manufacturer	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
All drifters:							
Clearwater	210	206	253	217	163	140	180
DBi	*	*	*	*	*	>278	>217
Marlin-Yug	752	577	78	162	466	*	>308
Metocean	356	373	396	384	211	190	146
Pacific Gyre	103	212	231	284	284	203	158
SIO	*	*	*	*	*	*	135
Technocean	394	522	497	476	262	148	53
"Quit" drifters:							
Clearwater	232	251	217	213	160	159	191
DBi	*	*	*	*	*	>278	>274
Marlin-Yug	849	635	856	634	>911	*	>284
Metocean	395	403	456	445	274	224	167
Pacific Gyre	159	264	598	336	345	242	214
SIO	*	*	*	*	*	*	160
Technocean	563	676	959	656	292	193	54

PERCENT LIVED <90 DAYS

Manufacturer	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Clearwater	8%	7%	11%	11%	26%	27%	13%
DBi	*	*	*	*	*	25%	9%
Marlin-Yug	0%	0%	6%	0%	18%	*	14%
Metocean	4%	7%	5%	6%	5%	11%	18%
Pacific Gyre	21%	12%	12%	17%	4%	5%	8%
SIO	*	*	*	*	*	*	6%
Technocean	13%	9%	8%	4%	11%	32%	55%

DROGUE HALF-LIFE (DAYS)

Manufacturer	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Clearwater	61	72	101	104	95	84	>247
DBi	*	*	*	*	*	>288	>217
Marlin-Yug	197	152	72	57	167	*	0
Metocean	299	>373	269	224	77	89	>115
Pacific Gyre	>282	210	200	241	248	>202	>183
SIO	*	*	*	*	*	*	>98
Technocean	30	45	33	63	77	154	>62

PERCENT THAT HAD DROGUE OFF <90 DAYS

Manufacturer	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Clearwater	61%	55%	36%	30%	36%	39%	14%
DBi	*	*	*	*	*	25%	9%
Marlin-Yug	0%	0%	41%	46%	36%	*	43%
Metocean	18%	13%	17%	26%	40%	46%	35%
Pacific Gyre	28%	20%	23%	17%	10%	16%	25%
SIO	*	*	*	*	*	*	33%
Technocean	61%	65%	78%	53%	46%	27%	31%

PERCENT THAT HAD DROGUE OFF <10 DAYS

Manufacturer	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Clearwater	6%	7%	4%	7%	7%	5%	2%
DBi	*	*	*	*	*	0%	4%
Marlin-Yug	0%	0%	24%	33%	9%	*	43%
Metocean	7%	8%	13%	6%	12%	6%	8%
Pacific Gyre	7%	8%	12%	8%	2%	4%	7%
SIO	*	*	*	*	*	*	24%
Technocean	27%	10%	11%	10%	9%	3%	14%

During the period 21 August—28 November 2012, 38 Pacific Gyre SVPGS (salinity with GPS) drifters were deployed as part of the Salinity Processes in the Upper Ocean (SPURS) campaign effort. The half-life of valid SSS/SST observations from these drifters was 224 days, with 8% providing good observations for <90 days and 21% providing good observations for <180 days. Many more salinity drifters were released in 2013, and their lifetime statistics will provide a more robust estimate of the lifetime of these drifters.

As noted by the DBCP Task Team on Best Practices in their 2013 report:

> The task team reminds the Panel that manufacturing improvements yielding longer drogue and/or drifter lifetimes will not be reflected immediately in the size of the global drifter array. Remotely-stored drifters with known manufacturing problems will in some cases continue to be deployed, and drifters already deployed will affect half-life calculations through 2013. Furthermore, there is an intrinsic lag from design and manufacturing to shipping, to deployment in significant quantities. As of this writing [March 2013], the global array still experienced ~150 deaths per 1250 drifters per

month, an anomalously high death rate attributable to the factors described in this report. As a consequence, despite the deployment of 123 drifters between 31 December 2012 and 4 February 2013, the array faced 132 deaths (including drifters that ran aground and were picked up) and decreased in size to 995 drifters on 4 February 2013. As drifters with reliable batteries, optimized transmission strategies and more robust drogues and tethers are deployed, we anticipate the number of drogues returning towards the goal of 1250 drifters through 2013 and the drogue lifetimes of drifters deployed in 2013 to increase.

5) Evolution of the Global Drifter array, 6 August 2012—5 August 2013

The growth of the array through 15 August 2013 is shown in Fig. 2. For the most recent 365 days, the array had an average size of 994 drifters, approximately the same as last year (990). This period began with the array at 1029 drifters and climbing, reaching a maximum of 1087 on 15 October. Starting in November, the array size began to diminish steadily as the number of deaths overtook the number of deployments. Through January 2013 the array size remained stable at around 1000 drifters, and climbed to 1014 drifters on 27 January 2013. Starting in early February, with increased deaths due in part to reduced lifetimes associated with PMT drifters operating in PTT mode, the array size began rapidly decreasing. It was at 924 drifters on 3 March. A large number of deployments in early April brought the array to 964, but the sustained high death rate brought the array to its minimum of 898 on 8 July. After this, a very high deployment rate and reduced death rate brought the array up to its current level of 1013 on 5 August 2013.

APPENDIX B

REPORT BY THE TROPICAL MOORED BUOY IMPLEMENTATION PANEL (TIP)

(Report submitted by Paul Freitag, NOAA/PMEL, USA)

1) Summary

Name of Action Group	The Tropical Moored Buoy Implementation Panel TIP
Date of report	31 July 2013
Overview and main requirements addressed	The Tropical Moored Buoys 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. A few moorings also have specialized instruments to measure turbulence dissipation. 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: 72 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), National Institute of Oceanography (NIO), Agency for the Assessment and Application of Technology (BPPT), Ministry of Marine Affairs and Fisheries (KKP), First Institute of Oceanography (FIO), Agulhas and Somali Current Large Marine Ecosystems (ASCLME), 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 2012/2013; and planned in 2013/2014)*	• PIRATA-17/TACE/TAV 10-14 September 2012, Kiel, Germany • CLIVAR/GOOS Indian Ocean Panel 9th Session 15-20 October, 2012, Capetown, South Africa • TIP Workshop, 23-24 October, 2012, Jakarta, Indonesia • CLIVAR/GOOS Indian Ocean Panel 10th Session 8-12 July, 2013, Li Jang, China • PIRATA-18/TAV 22-25 October 2013, Venice, Italy • Tropical Pacific Observing System Review, January 2014, location TBN
Current status summary *(July 2013)*	TAO/TRITON: 45 of 67 surface moorings reporting. PIRATA: 18 of 18 surface moorings reporting. RAMA: 18 of 26 surface moorings reporting.
Summary of plans for 2014	TAO/TRITON: Maintain 72 mooring array. PIRATA: Maintain 18 mooring array RAMA: Maintain 32 sites and add 2 more sites.

2 Deployment plans for mid-2013 to mid-2014

TAO/TRITON: NDBC 6 cruises, JAMSTEC 1 cruise
PIRATA: AOML/PMEL 1 cruise, IRD 1 cruise, INPE 1 cruise
RAMA: PMEL/INCOIS 4 cruises, JAMSTEC 1 cruise, NIO 1 cruise, PMEL/BPPT 2 cruises, FIO/BPPT 1 cruise, PMEL/ASCLME 1 cruise

3 Data management

3.1 Distribution of the data

Most surface data are telemetered in real time via the Argos system and are placed on the GTS by the French Space Agency (CLS). These real time data plus delayed-mode data (data of higher temporal resolution than are available in real time and data from subsurface moorings) are available via web based distribution from PMEL (www.pmel.noaa.gov/tao/disdel/disdel.html), NDBC (tao.noaa.gov), JAMSTEC (www.jamstec.go.jp/jamstec/TRITON/real_time/php/top.php, http://www.jamstec.go.jp/iorgc/iomics/datadisplay/buoysummary.php?LANG=0), and NIO (www.nio.org/index/option/com_nomenu/task/show/tid/2/sid/18/id/5). One surface mooring (FIO) telemeters data via Iridium which are available via the web only. During the period July 2012 through June 2013 the PMEL web pages had more than 14M hits and delivered more than 371K data files in response to more than 61K user requests. In addition to web page deliveries, more than 1.4M 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

Most surface moorings are Autonomous Temperature Line Acquisition System (ATLAS) moorings which place daily mean meteorological and oceanographic observations and some (about 10 per day on average) hourly meteorological observations on the GTS using Argos2 PTTs. ATLAS 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. TRITON and 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.

Daily average data return for the period 1 July 2012 through 30 June 2013 was 53% for TAO, 90% for TRITON, 78% for PIRATA and 65% for RAMA. Abnormally low TAO data return was in large part due to cancellation and delays in cruises. The average TAO mooring age (time period since deployment) was 15 months as of July 2013. Forty-five (45) of 55 TAO moorings have been deployed for more than the design lifetime of 12 months, with some having been deployed for as long as 29 months. Primary reasons for data loss in RAMA were a high incidence of vandalism coupled with longer mooring deployment periods at some moorings. Intense fishing activity has lead to high vandalism rates in some regions. The survival rate for ATLAS moorings in RAMA since initial deployments in 2004 is 82%, compared to 90% for TAO (1980 to 2010) and 93% for PIRATA (1997-2013). . Four RAMA moorings were not serviced due to either insufficient sea days or bad weather during a cruise. Another RAMA mooring was not serviced because the ship operator would not enter the piracy high-risk zone defined by Lloyds of London.

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 site (http://www.pmel.noaa.gov/tao/), PIRATA web site (http://www.pmel.noaa.gov/pirata/), and RAMA web site (http://www.pmel.noaa.gov/tao/rama/) provide various information including scientific background, technical information, access to RAMA data and displays, present status of the array, a bibliography 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 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 at www.pmel.noaa.gov/tao/proj_over/sensors.shtml for ATLAS moorings, at www.jamstec.go.jp/jamstec/TRITON/real_time/overview.php/po-t3.php for TRITON moorings, and at http://www.jamstec.go.jp/iorgc/iomics/projectoverview/1_b3_eng.html for m-TRITON moorings. RAMA mooring specifications from PMEL, JAMSTEC and NIOT are also listed in the Supplement to RAMA: The Research Moored Array for African—Asian—Australian Monsoon Analysis and Prediction (McPhaden, et al., 2009)

After testing and comparison of real-time (daily averaged) and delayed mode (10-minute) data alongside ATLAS moorings for several years, NDBC's ATLAS Refresh moorings have replaced ATLAS Legacy moorings at 28 of 55 TAO sites. The remaining ATLAS sites will be replaced with Refresh systems in the coming year. Refresh systems telemeter 10-min resolution data via Iridium each hour, and data are placed on the GTS. A report on multi-year testing of ATLAS Refresh systems is nearing completion.

China's First Institute of Oceanography (FIO) implemented the 8°S 100°E RAMA site in February 2010 and has maintained the site on an annual basis since then. The FIO mooring, named Bai-Long was designed to make air and ocean measurements comparable to ATLAS moorings. PMEL and FIO have incorporated data from the Bai-Long 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 tropical research arrays, which is essentially equivalent to ATLAS, while using more commercially available components and providing higher temporal resolution data in real time. Six prototype systems have been deployed for comparison with ATLAS systems. Replacement of some ATLAS systems in PIRATA and/or RAMA with T-Flex systems will begin in 2014.

The new T-Flex and Bai-Long mooring systems telemeter data via Iridium. Methods to submit data from these systems onto the GTS are being developed.

5) Other issues

5.1 RAMA Implementation

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

Between July 2012 and June 2013, 159 sea days were provided by India, Japan, Indonesia, South Africa, Australia and China in support of RAMA. During this period 29 RAMA moorings were serviced. As of July 30, 2013, 18 of 26 surface moorings were reporting data. Eight surface moorings had not been serviced for more than one year. Two moorings had gone adrift and had not yet been replaced.

5.2 PIRATA Extensions

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

5.3 Array enhancements

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

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

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

5.4 International cooperation and capacity building

A number of formal bilateral agreements exist among agencies of the United States, India, Indonesia, Australia and ASCMLE to help complete and sustain RAMA. Several of these are due to be renewed in the coming year.

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 fourth meeting in July 2013 in Li Jang, China, in coordination with the 10th CLIVAR/GOOS Indian Ocean Panel session.

The Korea Institute of Ocean Science & Technology (KIOST) plans to deploy subsurface ADCP near TAO moorings along 165ºE. First deployments are planned for the summer or 2013. This work is being conducted under the context of a Joint Project Agreement between NOAA and the Ministry of Land, Transport and Maritime Affairs, Republic of Korea. The third NOAA-KIOST Ocean Climate Seminar was held in Seattle in May 2013.

JAMSTEC's Dr. Iwao Ueki visited PMEL from April, 2012, to March, 2013, strengthening the long-term ties between the 2 agencies. Mr Huiwu Wang from FIO visited PMEL for 3 months in fall 2012 to collaborate on mooring technology and data processing procedures. NOAA hosted a capacity building workshop in Indonesia (October 22-24, 2012) and also site visits in the US by Indonesian scientists to the National Coastal Data Development Center (NCDDC) and NDBC (September 17-25, 2012.) Engineers from NIOT will visit PMEL and NDBC in August 2013.

5.5 TAO Transition

All TAO sites will have been deployed with NDBC's ATLAS Refresh mooring systems by the end of 2014, marking the completion of the transition of TAO operations and maintenance from PMEL to NDBC.

5.6 Research experiments

The US is conducting 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.

The Monsoon Onset Monitoring and its Social and Ecosystem Impacts (MOMSEI) is a Southeast Asia GOOS (SEAGOOS) pilot project under IOC-WESTPAC. MOMSEI aims at observing boreal summer monsoon onset and understanding the role of ocean in this process. Observations include field surveys over the eastern equatorial Indian Ocean and the Bay of Bengal.

5.7 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, the Gulf of Guinea and equatorial Indian Ocean. In response, some TRITON sites which have been vandalized heavily are now deployed without meteorological sensors.

5.8 Piracy

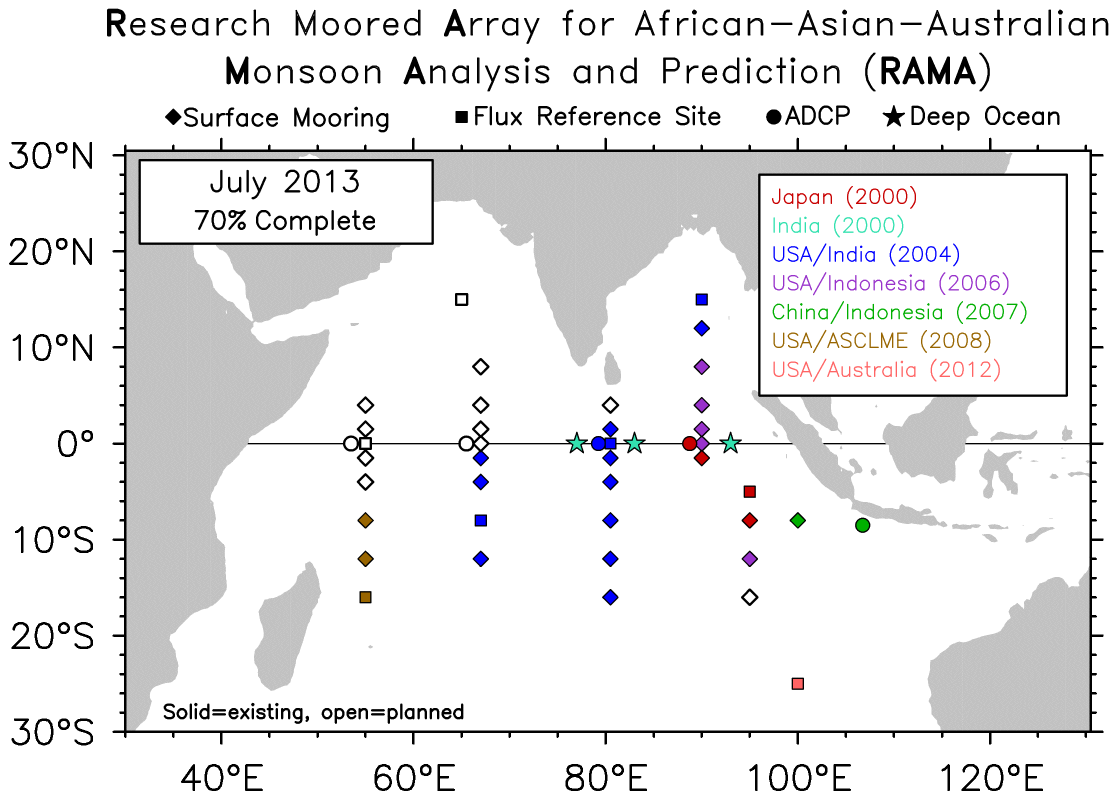
In addition to vandalism, well-publicized piracy events have resulted in the suspension of RAMA implementation off Africa and in the Arabian Sea. Lloyds of London defines an Exclusion Zone (EZ) north of 12°S and west of 78°E in which additional premiums apply to insure commercial vessels. INCOIS contracted Sea Marshalls to be stationed aboard MoES RAMA cruises with the EZ. South Africa would not permit the RV Algoa to enter the EZ in 2013. Although pirate attacks have diminished in the past 1-2 years, both in number and distance from Somalia, Lloyds has not reduced the area of the EZ. Pirate attacks in the Gulf of Guinea have increased in number and are of concern for future PIRATA cruises in that region.

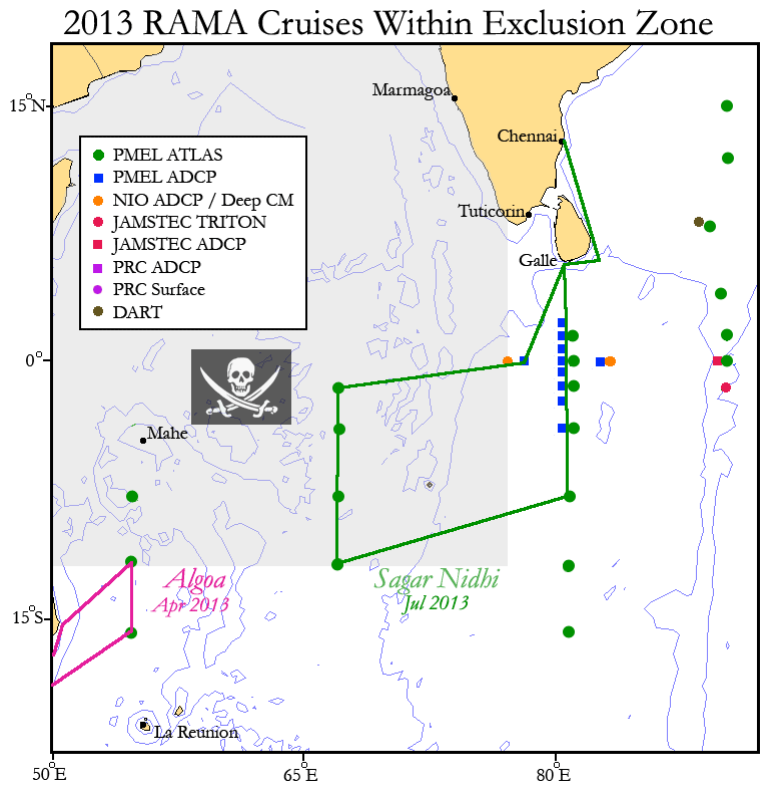
	2010	2011	2012	2013 (through July)
Vessels Hijacked	51	27	7	0
Vessels Boarded	16	17	1	0
Vessels Fired Upon/ Attempted Boarding	119	122	24	4

Source: U.S. Office of Naval Intelligence

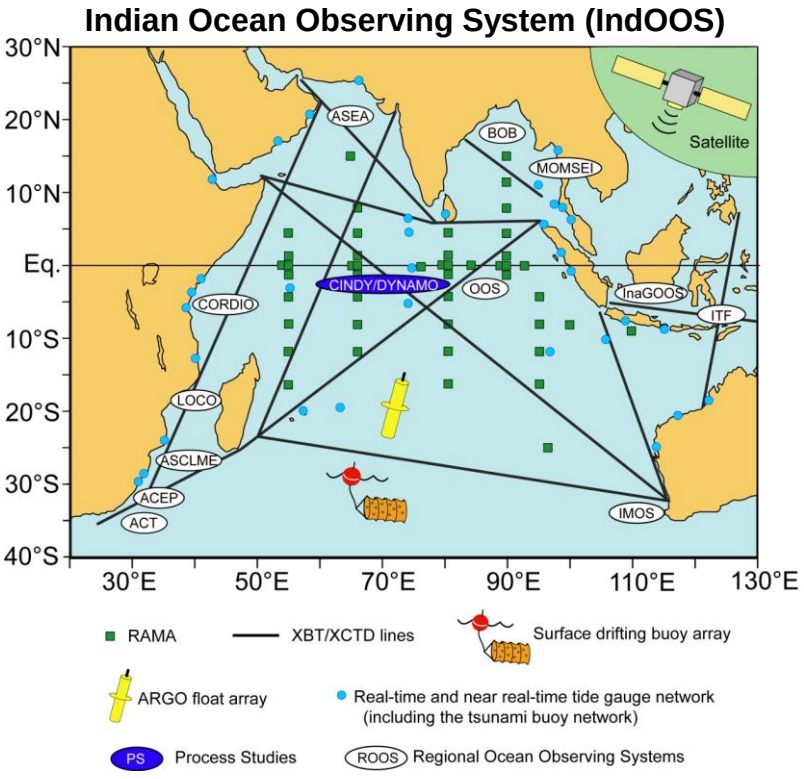
Annex

RAMA Implementation Status





2013 RAMA cruises within or near the Lloyds of London Piracy Exclusion Zone (shaded area). Sea Marshals were aboard the RV Sagar Nidhi in July 2013 (green line). The agency operating RV Algoa did not permit entry into the Exclusion Zone in April 2013 (magenta line). As a result the RAMA mooring at 8°S, 55°E was not replaced.



APPENDIX C

REPORT BY THE EUCOS SURFACE MARINE PROGRAMME (E-SURFMAR)

(Report submitted by Jean Rolland, Météo France)

1) Summary

Name of Action Group	**Operational Service of the Network of European Meteorological Services, EUMETNET (E-SURFMAR)**
Date of report	31 July 2013
Overview and main requirements addressed	The EUMETNET operational service E-SURFMAR is an optional programme involving 19 out of the 29 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 and the Mediterranean Sea (90°N-10°N; 70°W - 40°E).
Type of platform and variables measured	Drifting buoys: air pressure, SST, (wind) 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	Manager E-SURFMAR: Mr Pierre Blouch, Météo-France Chairperson, Expert Team-Data Buoy (ET-DB): Mr Jon Turton, UK Met Office
Coordinator	Data buoy Manager: Mr Jean Rolland, 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 SOC ISDM (Canada) as RNODC/DB
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-DB10 Oslo 12-13 June 2013
Current status (mid-2013)	113 E-SURFMAR drifting buoys in operation (86 Iridium, 25 Iridium upgrades +1 Argos upgrade + 1 ICEB) + 44 others reporting AP. 4 E-SURFMAR supported moored buoys in operation, plus a further 40 others operated by members.

Summary of plans for 2014	Maintain a network of 100 drifting buoys, and the 4 reference moored buoys in operation.

2 Deployment plans for 2014

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 (Iridium)) will deployed in the E-SURFMAR area of interest in the coming twelve months. New deployment routes will be investigated.

E-SURFMAR will continue to be involved in the GHRSST/DBCP Pilot Project in which the DBCP collaborates with the Group on High Resolution Sea Surface Temperature (GHRSST) to make measurements of 0.01°C precision from drifters.

E-SURFMAR will continue to deploy buoys in the Arctic Ocean through 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. At present, Cabo Silleiro, K5 and Lion are equipped to report directional wave spectra. Spectra data from K5 and Lion are disseminated on GTS by the Met Office. It is expected that a version of the system developed by the Met Office for K series buoys will be also installed on M6 in due course.

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. The 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.

Ninety nine percent of drifters operating are now using Iridium. This improves the data timeliness (see Annex). The number of daily observations carried out on to the GTS has now increased from about 2,000 to more than 2,800. The target (90%) of the percentage of data received within 50 minutes was maintained. 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 decreased to 253 days (273 days last year). Ninety three buoys failed to report air pressure measurements.

The availability of moored buoy data depends on the number of buoys operating. More than 90 hourly observations per day have been reported from E-SURFMAR buoys to the GTS.
Since buoy Cabo Silleiro was taken into account in the performance computations, the percentage of EUCOS moored buoys data available within 50 minutes dropped from 100% to 75% i.e. below the target of 90%. The problem of timeliness was resolved by Spain (in June 2013) and the delays are now by 20-40 minutes.

3.1.3 Delayed mode data exchange

The raw data from drifters are archived at “Centre de Meteorologie Marine” (CMM) at Meteo-France. Data inserted onto the GTS 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.
The agreed (DBCP) content (ver1) for moored buoy (MB) metadata is given at http://www.jcommops.org/dbcp/data/metadata.html. The intention being that the MB metadata will be compiled by the buoy operators and submitted to JCOMMOPS who would make it available to users. Although netCDF format has been suggested for upload of the metadata to JCOMMOPS, many users would prefer an alternative (simpler) format.

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 14-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 except in December 2012. The RMS of AP differences still has a seasonal variation, being higher in winter than in summer.

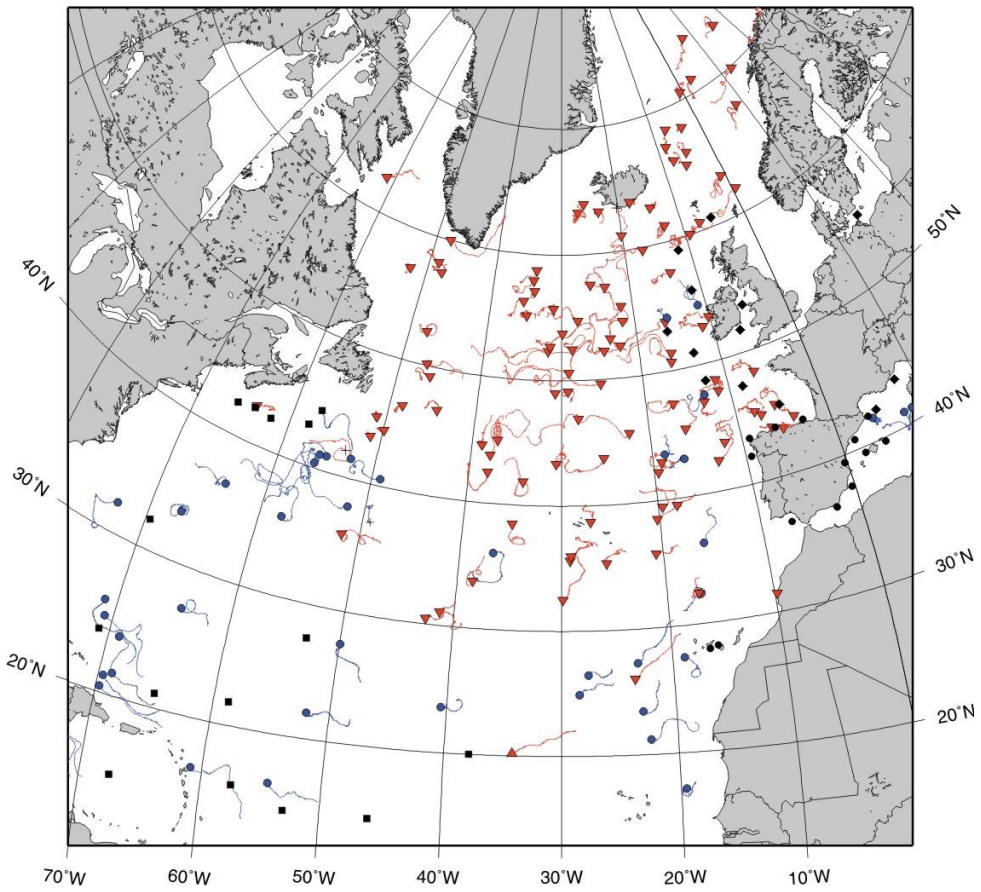
For moored buoys the Air Pressure (AP) differences with the French the target of 0.5% of Gross Errors was achieved except in December 2012. The RMS of AP differences are about 0.6 -0.8 hPa.

4) Instrument practices

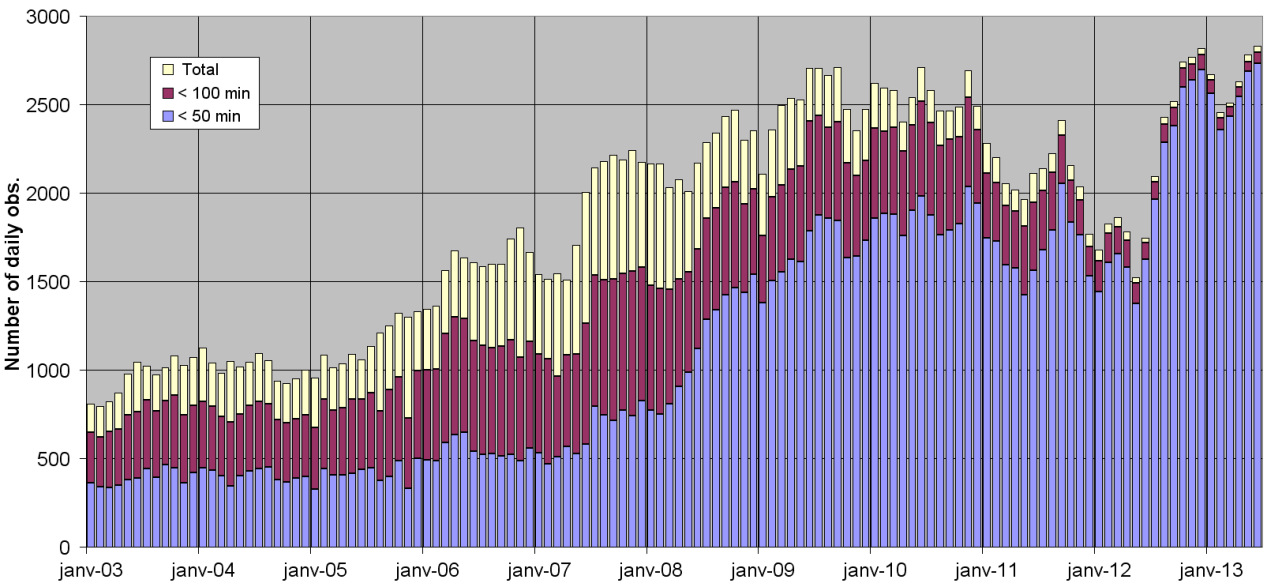
ESURFMAR drifting buoys uses recommended DBCP formats (DBCP-M2 for Argos, formats published on Iridium PP website for Iridium).

A technical document on E-SURFMAR moored buoys was issued.

Annex



Drifting buoy trajectories and moored buoy positions
(June 2013)



Drifting buoys data availabilty

APPENDIX D

REPORT BY THE INTERNATIONAL BUOY PROGRAMME FOR THE INDIAN OCEAN (IBPIO)

(Report submitted by Jean Rolland, Météo France)

1) Summary

Name of Action Group	International Buoy Programme for the Indian Ocean IBPIO
Date of report	31 July 2013
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
Type of platform and variables measured	Drifting buoys: Air pressure, SST, (wind) Moorings: air pressure, wind, air temperature, SST, waves, relative humidity, SSS, current…
Targeted horizontal resolution	500 km x 500 km
Chairperson/Managers	Mr Graeme Ball, BoM, Australia
Coordinator	Mr Jean Rolland, Météo-France
Participants	Australia (ABOM), France (Météo-France), India (NIO, NIOT, INCOIS), Kenya (KMD), South Africa (SAWS), Mozambique (EMU); USA (GDP, Navoceano), TIP (Tropical Moored Buoy Implementation Panel).
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 16 in Paris (France) in September 2013
Current status (mid-2013)	90 drifters (71 with Air Pressure) 43 moored buoys (31 for RAMA 67% of the planned 46 site array)

Summary of plans for 2014	To reach a network of 150 drifters. Maintain the moored buoy arrays.

2 Deployment plans for 2014

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. More than 200 drifters are planned to be deployed during the next intersessional period, of which 1/3 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 deploy 9 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 40 in 2013-2014).

RAMA maintenance will continue in the coming year with a potential for more than 200 sea days to be provided by 7 countries in support of 34 moorings. The CLIVAR/GOOS Indian Ocean Panel and the IndOOS Resource Forum conducted meetings during the week of October 15-20, 2012 in Capetown, South Africa and on July 8-12, 2013 in Li Jiang, China. PMEL will host a technical training session on mooring systems for 3 NIOT engineers in August 2013.

NIOT will maintain a network of 12 deep sea buoys with subsurface measurements radiation and precipitation sensors (Ocean Observation Systems, OOS). They are working at 7 sites in Bay of Bengal and 5 in Arabian Sea. This is similar to RAMA mooring also in addition these OMNI buoys have current measurements. These OMNI buoys systems have given new scientific in-sight into oceanic processes during cyclones in Bay of Bengal such as JAL, Thane, Neelam and Mahesan. These OMNI buoys will be maintained along with 4 coastal buoy systems.

In the Southern part of the Indian Ocean (South of 35 S), the deployment of SVP-B drifters provided by GDC and upgraded by Météo-France (about 30 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 the RV Marion Dufresne during her 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, through the PMO in Cape Town, will continue to coordinate the deployment of drifters on behalf of GDP, ABOM and Météo-France from voyages to Marion Island. The ABOM plans to provide 2 SVP-B buoys for deployment from the scheduled voyages in 2014.

As in previous years, the GDP remains the biggest contributor to the IBPIO, with more than 100 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 was maintained. The chain is able to produce FM13-SHIP, FM18-BUOY or FM94-BUFR messages.

The use of the Iridium communication system continued. Thirty five drifters using Iridium were deployed (45 last year). This improves the data timeliness. One hundred and fifty four drifting buoys (233 last year) were deployed of which about 87% measured air pressure (SVP-B). About 2500 daily observations were carried out on to the GTS by August 2012. This number decreased regularly along the intersessional period to 1500 by April 2013 (see Annex) due to the decline in number of operating drifters. The percentage of data received within 50 minutes was about 50% during the year due the use of Iridium system and the improvment of the Argos system in respect of timeliness.

In July 2013, 15 of 25 RAMA moorings were reporting on the GTS (WMO ID's 14040, 14041, 14042, 14046, 23004, 23006, 23007, 23009, 23010, 23017, 53005, 53006, 53040, 53053, 53055), 8 of the 12 deep sea NIOT moored buoys too (WMO ID's 23091, 23093, 23094, 23095, 23097, 23459, 23460, 23494).

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/).

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.

Due to the decline in the number of operational drifters noted in 3.1.2, the number of daily messages sent onto the GTS dropped from 2500 to 1500 during the intersessional period.

For drifters the Air Pressure (AP) differences from the French model outputs were lower than 1% of Gross Errors. The RMS of AP were stable around 0.8 hPa.

NIOT has developed new data acquisition and Quality Control software called ADDRESS.

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.

5) Issues: maintenance of moored buoys

Between July 2012 and June 2013, 133 sea days were provided in support of RAMA sites. Sea days were provided by Japan, India, Indonesia, South Africa, China and Australia. During this period 25 moorings were serviced, including the implementation of 1 new site at 25°S - 100°E. Forty drifters were deployed on RAMA cruises in the past year

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 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. RAMA cruises aboard Indian research vessels continue to embark sea marshals for security. South Africa refused to allow the R/V Algoa into the Exclusion Zone in April 2013, resulting in a RAMA mooring not being replaced on schedule.

Vandalism and Piracy are major challenges in maintaining the surface moorings in Northern Indian Ocean. NIOT continue to face problems in maintenance of buoys. Awareness exercises being carried by organising meetings with Deep sea fishers, distribution of Posters through Ports in India. Also in Sri Lanka national agencies such as National Aquatic Resources Research and Development Agency, Department of Fisheries & Aquatic Resources, the National Disaster Management Authority Sri Lanka support this campaign

In Arabian Sea two cruises were undertaken with armed guards to service buoy systems. Government of India though Ministry of Earth Sciences are providing fullest support to Moored buoy programme

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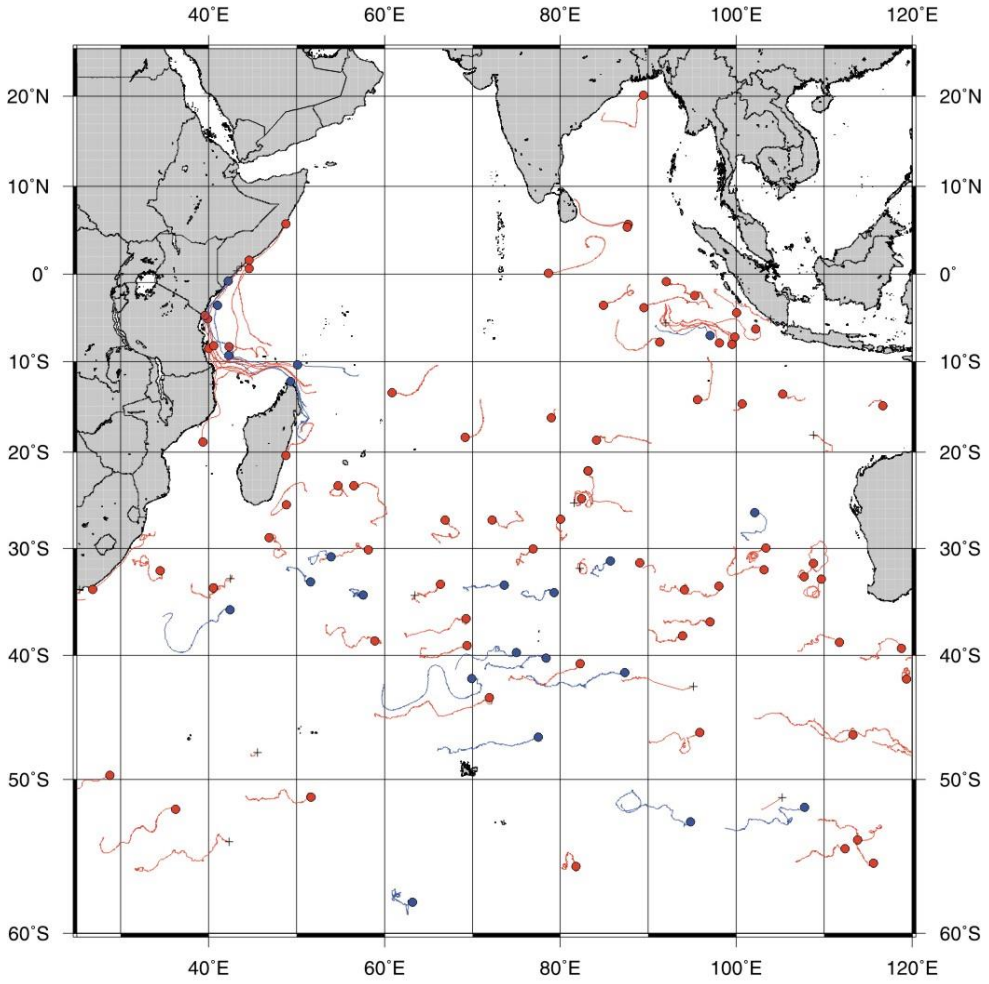
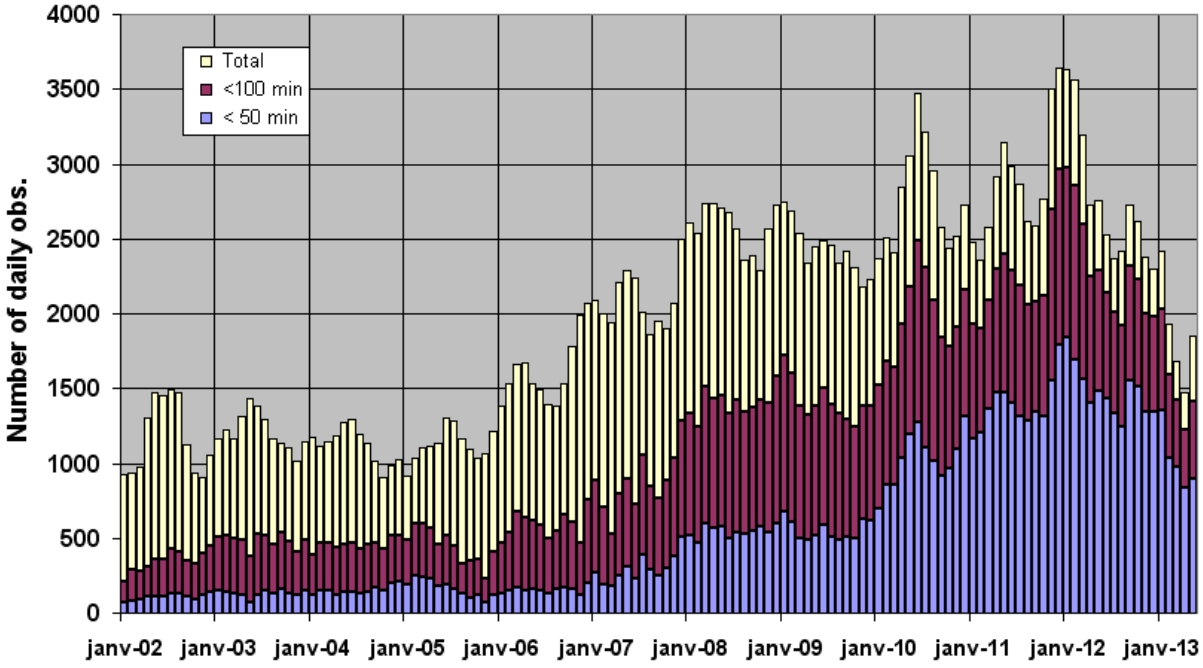
ANNEX



Drifting buoys trajectories (June 2013)



Drifting buoys data availability

APPENDIX F

REPORT BY THE DBCP-PICES NORTH PACIFIC DATA BUOY ADVISORY PANEL (NPDBAP)

(Report submitted by Shaun Dolk, NOAA/AOML, USA)

1) Summary

Name of Action Group	DBCP-PICES North Pacific Data Buoy Advisory Panel (NPDBAP)
Date of report	31 July 2013
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	Al Wallace, Chris Marshall, Joe Linguanti, Ignatius Rigor, and Shaun Dolk
Data centre(s)	Drifter Data Assembly Centre (DAC) Integrated Science Data Management (ISDM), Canada
Website	http://npdbap.noaa.gov/
Meetings *(meetings held in 2011/2012; and planned in 2012/2013)*	Yearly meetings usually held in conjunction with DBCP meetings. Next meeting planned 24 September, 2013 in Paris, France
Current status summary *(mid-2012)*	From 01 August 2012 to 31 July 2013, 122 drifters were deployed in the North Pacific Ocean. Of the 122 drifter deployments, 78 units were equipped with barometer sensors and the remaining 44 drifters were standard SVP type drifters.
Summary of plans for 2013	The goal for 2014 is to deploy 100 drifters, from which, 60 drifters will be equipped with barometer sensors.

2 Deployment plans for 2013

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 (July 2013), data are available through June 2013. 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 Dec 2009 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

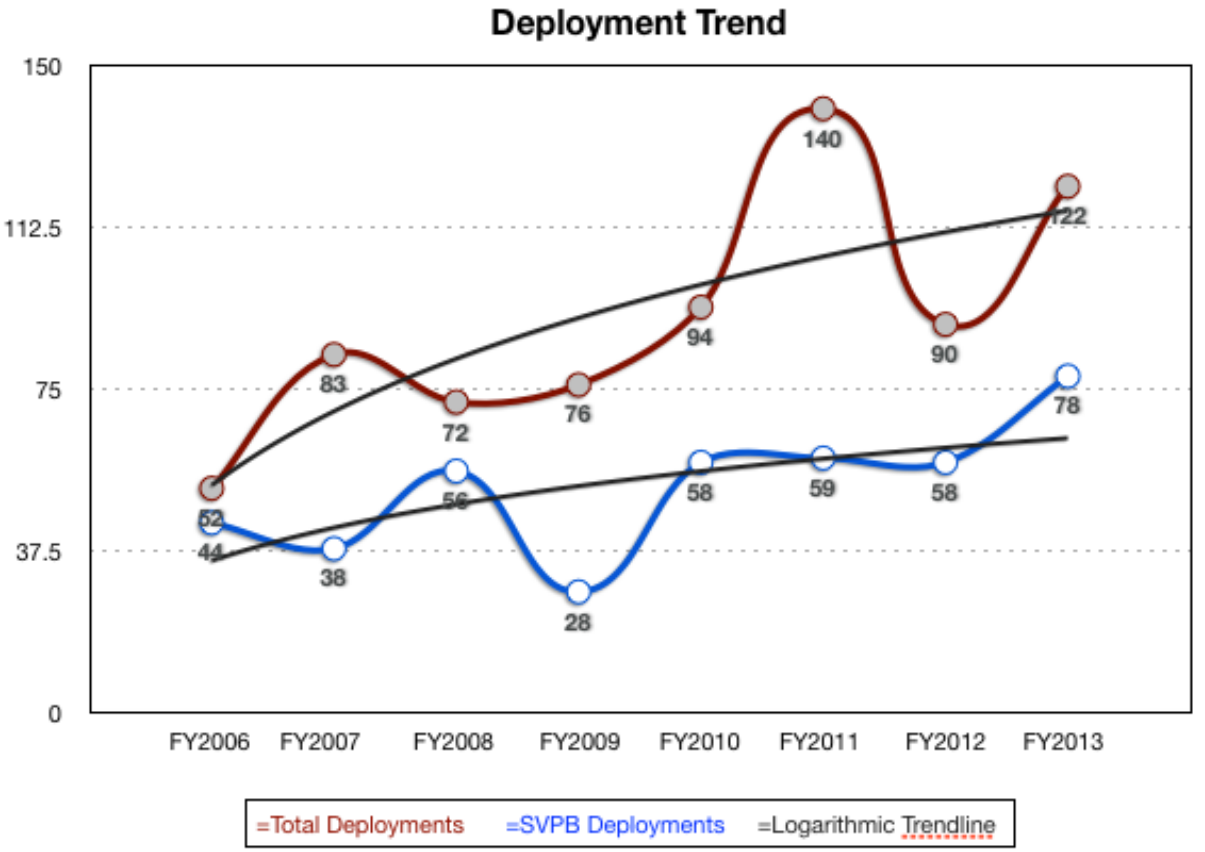
4) Instrument practices

5) Other issues as needed

Annex
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



REPORT BY THE INTERNATIONAL ARCTIC BUOY PROGRAMME (IABP)

1) Summary

Name of Action Group	International Arctic Buoy Programme IABP
Date of report	11 September 2013
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 2012/2013; and planned in 2013/2014)*	Annual meetings spring or early summer in the Northern Hemisphere. 23rd Annual Meeting of the International Arctic Buoy Programme [IABP], hosted by the US Naval Academy in Annapolis, Maryland, in , 11 – 12 July 2013. We are tentatively planning to have our next meeting at the Alfred Wegener Institute in Bremerhaven, Germany in May, 2014.
Current status summary *(mid-2013)*	Eighty buoys were reporting, 59 of which have barometers, and/or surface temperatures sensors (Fig. 1).
Summary of plans for 2014	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 2014

Deployment plans for 2013 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 DBCP-27/Doc. 7 Rev. 1, Appendix F, p. 2 *make then known to 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 (http://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

Status maps and graphics

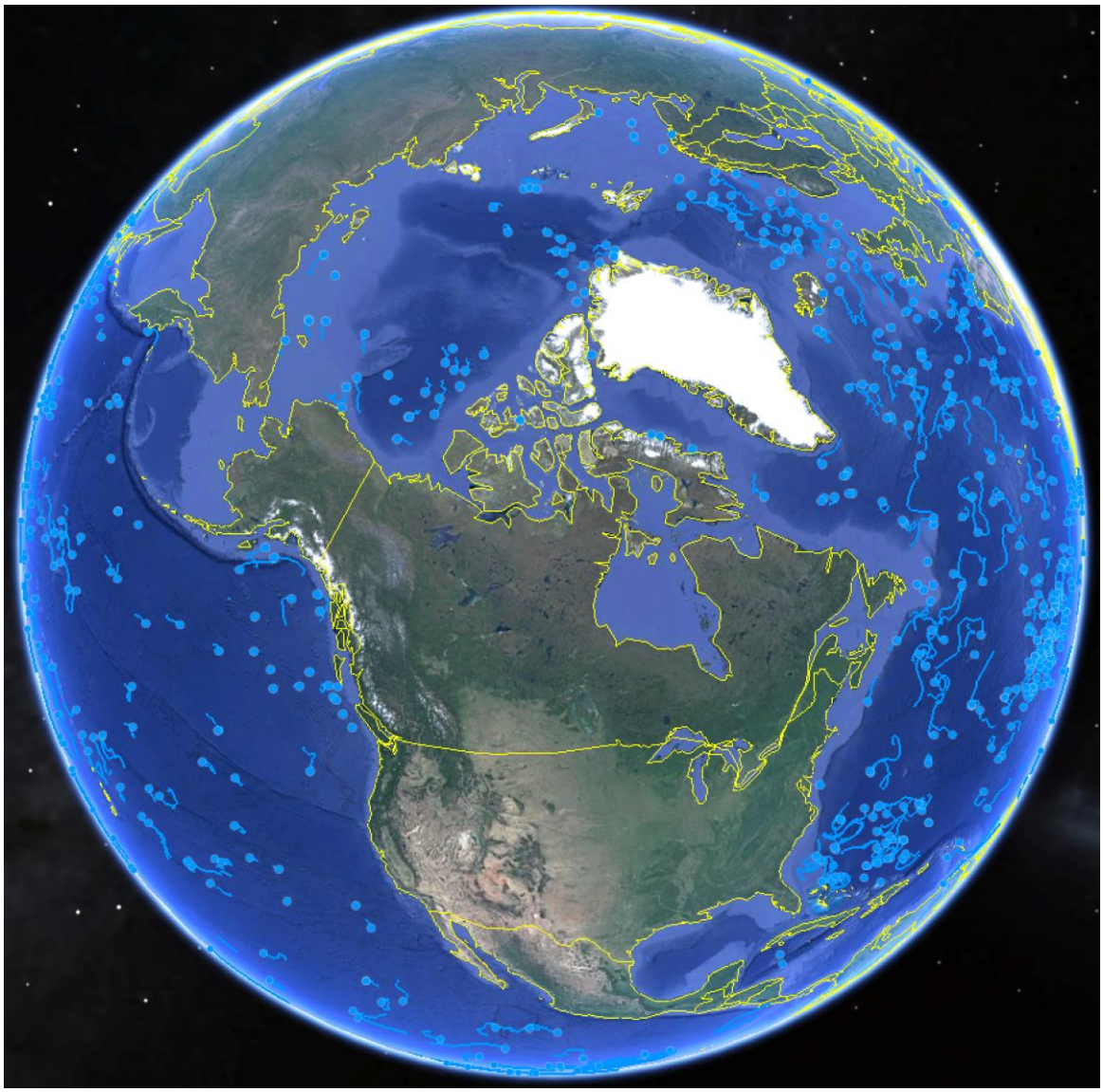


Figure 1. Map of buoy positions on 13 July 2013 from JCOMMOPS. Eighty buoys were reporting, 59 of which have barometers, and/or surface temperatures sensors.

REPORT BY THE WCRP-SCAR INTERNATIONAL PROGRAMME FOR ANTARCTIC BUOYS (IPAB)

(Report submitted by Christian Haas, Canada)

1) Summary

Name of Action Group	
Date of report	Sept 10, 2013
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: Basic variables: Buoy position, atmospheric pressure and SST Other variables: Air temperature, ice and / or snow temperature, atmospheric pressure tendency, wind, snow and 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 2012/2013; and planned in 2013/2014)*	IPAB participants reported during the annual meeting of the International Arctic Buoy Programme in Annapolis, MD, on July 19 & 20, 2013. The next IPAB meeting is planned to coincide with the IGS sea ice symposium in Hobart, Tasmania, in 2014. http://seaice.acecrc.org.au/igs2014/
Current status summary *(mid-2013)*	IPAB activities have significantly increased in 2012 and 2013, with the deployment of 10 buoys in the northern and >40 in the southern Weddell Sea, 23 in the Ross, Amundsen, and Bellingshausen Seas, and >10 off the coasts of East Antarctica. These include several new buoy types developed for acquisition of additional atmospheric, ice, and ocean data. 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 2014	Main deployments will be during the German icebreaker cruises to the southern Weddell Sea in late 2013, and during USIPAB cruise to Ross/Amundsen Sea in January/February 2014.

2 Deployment plans for 2014

Few activities are planned for the 2013/2014 season. The German icebreaker RV Polarstern operates in the southern Weddell See from December 2013 to March 2014 during cruise ANT XXIX/9, and plans to deploy 4 snow buoys and 50 sonar buoys.
The USIPAB program will continue to deploy a number of buoys in the Ross/Amundsen/Bellingshausen Sea during February and March 2014.
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

For the 12 months from June 2012 to May 2013 for the IPAB area of interest (south of -55°), primarily represented by the WMO sub-areas 71, 72, 73, 74 and southern portions of 16,17, 33, 34, 55 and 56 ISDM archived 207855 (321607*) messages from 99 (132*) buoys reporting on the GTS.

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

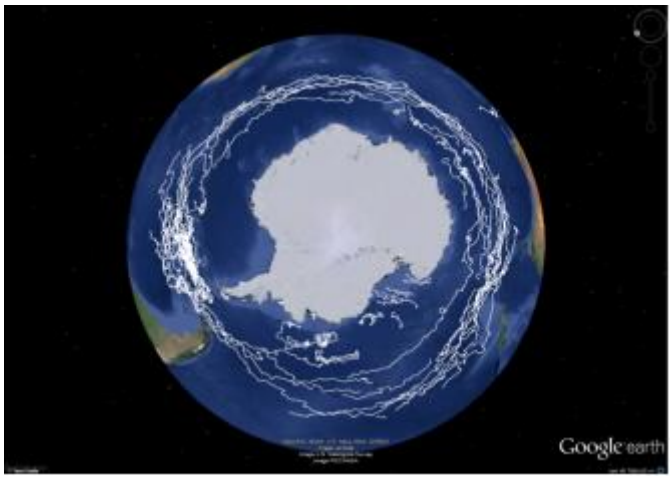
5) Other issues as needed

SATCOM

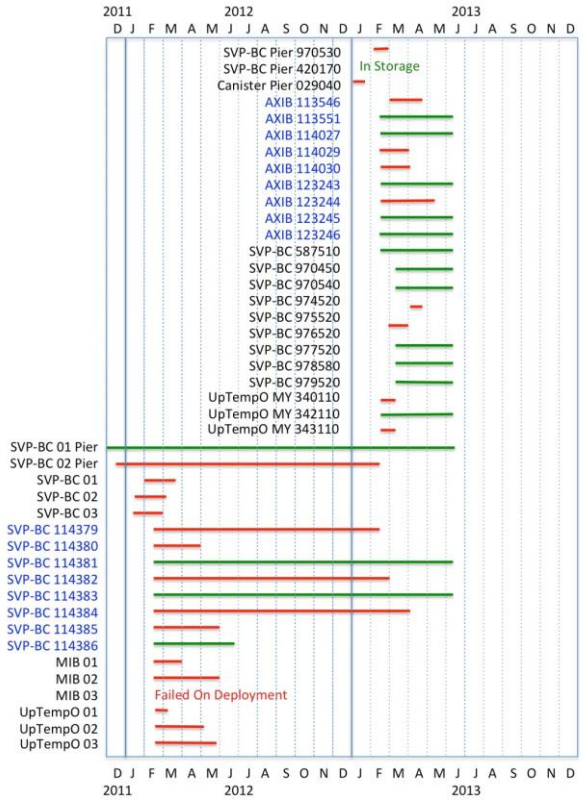
IPAB considers the recent SATCOM initiative as very important and wishes to contribute. IPAB has formulated these requirements for Polar Observations:

- main issues are continuous coverage of high latitudes (90N - Arctic), with sufficient band width, e.g. increase Iridium SBD size to 1000 bytes
- amount of data transmitted and how frequent, real time/delayed mode etc?
- More data could be sent e.g. with Rudex system, which should be simplified
- What are Globalstar plans for Polar Regions?

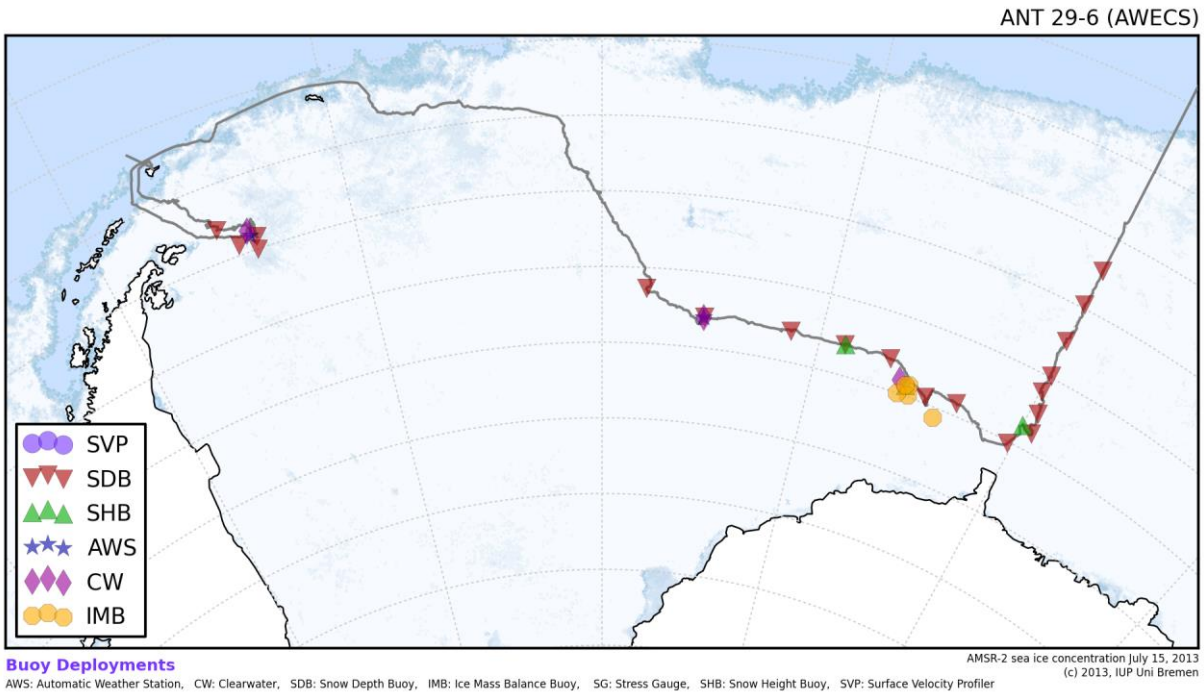
Status maps and graphics



Buoy Tracks in the IPAB area of interest from July 2012 to June 2013; Map provided by Bruce Bradshaw, ISDM, Dept. of Fisheries and Ocean, Ottawa, Canada. More products and services will be available online based on the work and features demonstrated on our monthly data product page http://isdm.gc.ca/isdm-gdsi/drib-bder/KML/MonthlyKML-eng.htm



Drifting buoy time lines of USIPAB buoys, status July 2013. Argos buoys shown in blue, Iridium in black. 2012 dployments: Bimodal survival, 3 are still reporting; 2013 deployments: Lost a 7 NPB buoys immediately, and both pier buoys. Overall: 15 of 42 Buoys still reporting in July 2013. Figure courtesy Ignatius Rigor, University of Washington, Seattle, USA.



Buoy deployments during German RV Polarstern cruise ANT-XXIXX/6. Figure courtesy Sandra Schwegmann, Stefan Hendricks, and Marcel Nicolaus, Alfred Wegener Institute, Bremerhaven, Germany

Argos ID	Date of deployment	Latitude	Longitude
109278	2012-12-12	55.0°S	000.0°E
109218	2012-12-13	60.0°S	000.7°E
109277	2013-01-19	59.6°S	020.0°W
109216	2013-01-20	59.5°S	025.0°W
109269*	2013-01-20	59.5°S	027.3°W
109273	2013-01-21	56.0°S	032.0°W
109214	2013-01-23	55.0°S	030.0°W
109268	2013-01-25	57.6°S	015.0°W
109275	2013-01-25	58.4°S	010.0°W
40304**	2013-01-25	59.2°S	005.0°W

*Buoy on South Thule **Redeployment of 2012 buoy on South Thule. Deployed without a drogue.

SVP-B deployments in December 2012-February 2013 by South African National Drifting Weather Buoy Programme (supported by NOAA and South African Weather Service (SAWS)). Information provided by Santjie du Toit, Sydney Marais, and Johan Stander, SAWS.

APPENDIX H

REPORT BY THE INTERNATIONAL SOUTH ATLANTIC BUOY PROGRAMME (ISABP)

(report submitted by Mayra Pazos, NOAA/AOML, USA)

1) Summary

Name of Action Group	**International South Atlantic Buoy Program ISABP**
Date of report	31 July 2013
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
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	Mr Ariel Troisi, SHN, Argentina
Coordinator	Mayra Pazos, AOML-NOAA, USA Johan Stander, SAWS, South Africa
Participants	
Data centre(s)	Historical drifter data are assembled, quality controlled at AOML, Miami, then sent to ISDM for archival and further distribution. Real time data is also archived at ISDM
Website	http://www.jcommops.org/dbcp/isabp/index.html http://www.oceatlan.org/isabp/en/index.html
Meetings *(meetings held in 2012/2013; and planned in 2013/2014)*	Meetings are held every other year, normally in May-July. Last meeting,ISABP- 13 took place in Buenos Aires, Argentina, on April 19, 2010
Current status summary *(mid-2013)*	As of August 12, 2013, there were a total of 109 drifters in the South Atlantic region, (65 SVP, 44 SVPB).
Summary of plans for 2014	Continue to address observational gap areas specially, in the Gulf of Guinea and Angola Basin; pursue recommendation of

	conducting studies and evaluate the impact of drifter pressure data and SST on the skills of numerical weather forecasting models for the region; increase number of SVPB in the region.

2 Deployment plans for 2014

Deployments during the last year (July 2012 through June 2013) are shown in Figure 1.
There were a total of 169 drifters deployed in the region, 113 SVP, 54 SVPB and 2 with salinity. 19 of the total number failed on deployment. 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, Tristan da Cunha, South Thule fishing vessels and several others.

There were 19 drifters, all SVPBs, deployed between 55^0 S and 65^0 S in the South Atlantic that were part of a regional study from various groups, most of which made it to the ISABP region soon after deployment. Figure 2 shows these deployments.

The GDP deployment plans from June 1, 2013 – May 31, 2014 are as follows:

Tropical Atlantic (20^0S – 30^0N): SVP=250 SVPB=50

Extra Tropical Atlantic (40^0S – 20^0S): SVP=20 SVPB=55

Southern Atlantic (60^0S – 40^0S): SVP=0 SVPB=115

3 Data management

3.1 Distribution of the data

These data are assembled and quality controlled at the GDP Drifter Data Assembly Center, and available through the DAC web page (http://www.aoml.noaa.gov/phod/dac/dacdata.php) and from ISDM web (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 12, 2013, there were 109 surface drifters in the South Atlantic region transmitting good quality data on the GTS. (South Atlantic Region defined to be 20^0N to 55^0S). Last year there were 140 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, twice a year, for further archival and distribution. AOML has sent data to ISDM through December 2011, and it is in the process of preparing a new update that will include data through December 2012.

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

3.2 Data quality

4) Instrument practices

5) Other issues as needed

Figure 3 shows the status of the drifter array in the region. As of August 12, 2013 there were a total of 109 drifters actively reporting, 65 SVP and 44 SVPBs.

Annex (optional)

Status maps and graphics

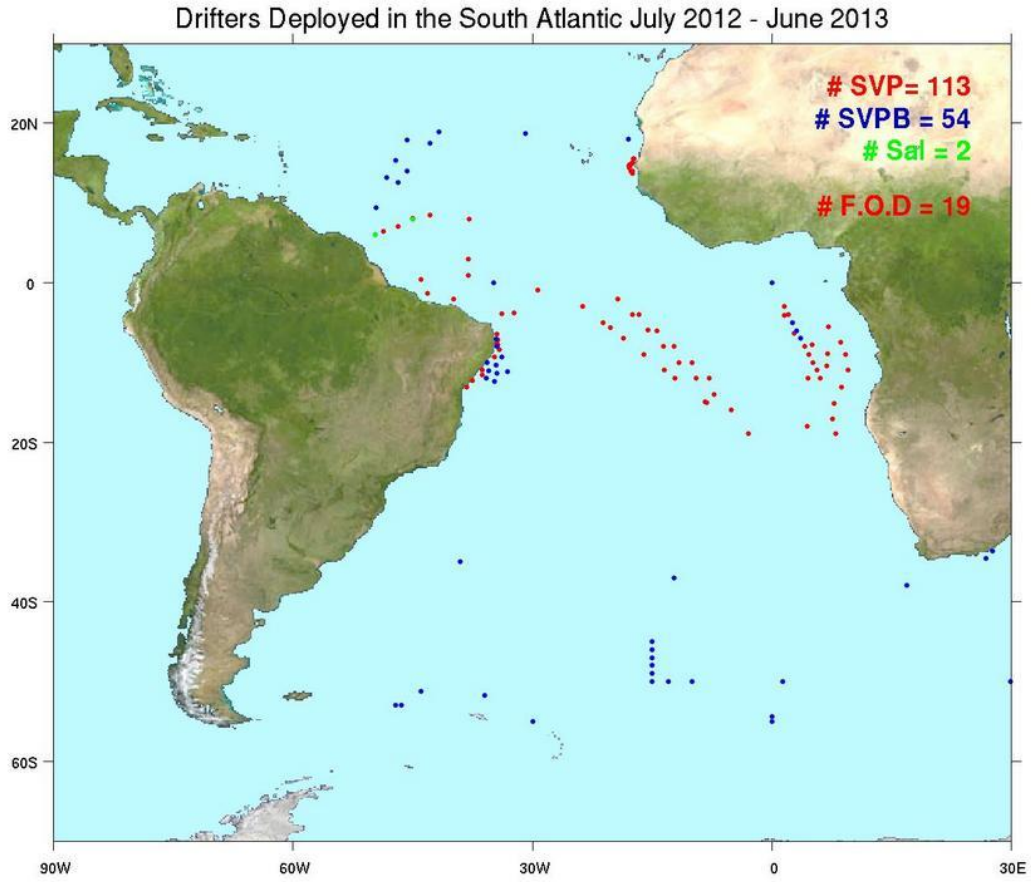


Figure 1. Deployment locations. A total of 169 drifters were deployed.

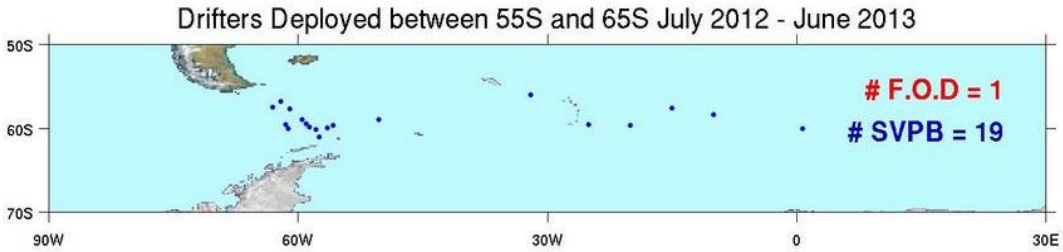


Figure 2. Deployment locations between 55^{0}S and 65^{0}S. A total of 19 drifters were deployed.

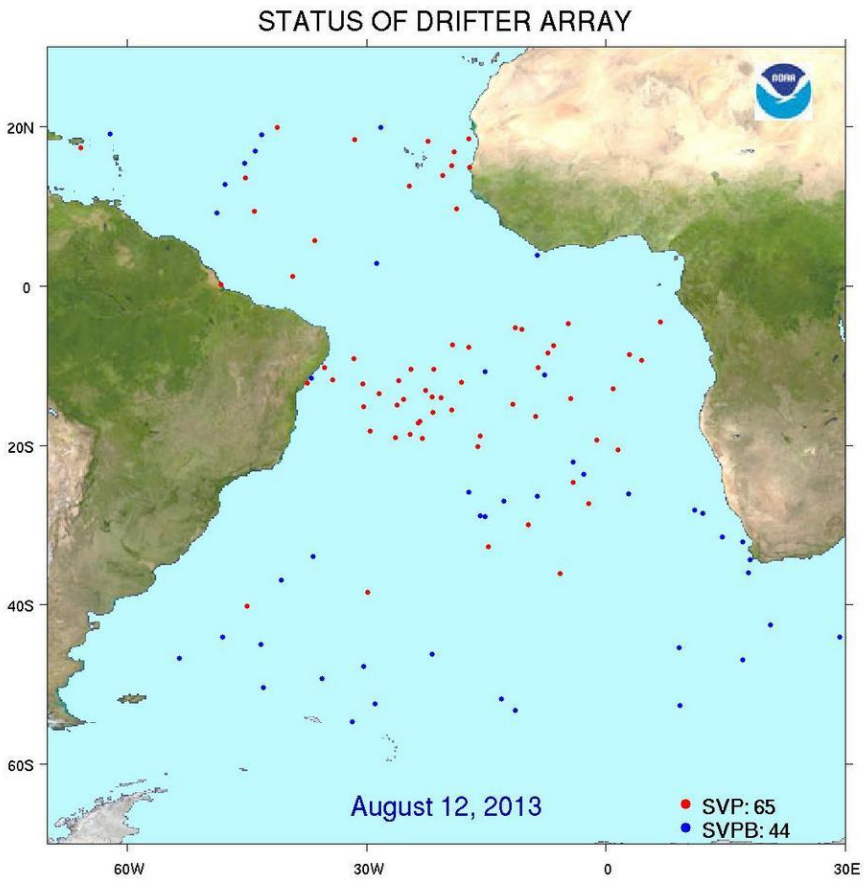


Figure 3. Status of the South Atlantic Array. A total of 109 drifters in the region as of August 12, 2013

APPENDIX I

REPORT BY THE OCEAN SUSTAINED INTERDISCIPLINARY TIMESERIES ENVIRONMENT OBSERVATION SYSTEM (OCEANSITES)

(Report submitted by Ms Kelly Stroker, OceanSITEs Coordinator, JCOMMOPS)

1) Summary

Name of Action Group	**OceanSITES**
Date of report	15 August 2013
Overview and main requirements addressed	OceanSITES is a worldwide system of long-term, deepwater reference stations measuring dozens of variables and monitoring the full depth of the ocean, from air-sea interactions down to 5,000 meters.
Area of interest	Global
Type of platform and variables measured	Deep-water reference stations
Targeted horizontal resolution	Key and representative sites covering the global ocean
Chairperson/Managers	Uwe Send, SIO Bob Weller, WHOI
Coordinator	Kelly Stroker, 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 *(2013)*	**2013** 9th Steering Committee and 6th Data Management Team Meetings in Seoul, Korea May 27-30, 2013 http://www.oceansites.org/meetings/index.html
Current status summary *(August-2013)*	The OceanSITES Network consists of over 177 reference sites in the deep-ocean with 51 of these sites transmitting data in real-time to a local or regional data centre (Figure 1). One of the main goals of OceanSITES is to share data in a common NetCDFformat. The format specifications have been developed by the OceanSITES Data Management Team (DMT) and currently over 30% of these sites are submitting data to one of the Global Data Assembly Centers (GDAC) in this format. At the December, 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 moorings 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 2). OceanSITES PIs have pledged to add such sensors to their existing moorings and as of May, 2013 another 14 sensors were installed with an additional 17 planned in the coming year. 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. In 2013, the OceanSITES site catalog was fully ingested into the JCOMMOPS database allowing for easier updates and version control.
Summary of plans for 2013-2014	In 2013, OceanSITES held a meeting in Seoul, Korea. The OceanSITES Executive Committee will continue to meet regularly as will the Data Management Team. Several new documents will be published to assist user's of OceanSITES data and possible new contributors: 1) an updated User's Manual (name changed to Data Reference Manual), 2) a new document entitled "How to Become an OceanSITES Member", 3) a new document entitled "How to work with the GDACs", 4) a new document entitled "How to Access OceanSITES Data". Updates to the OceanSITES website by the Project Office. Finalization of concrete metrics for OceanSITES which the executive committee has been working. The 3 disciplines will have small teams to write White papers 1) Air sea flux 2) Physical time-series (ocean circulation, deep changes) 3) Biogeochemical and ecosystem 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. Review and finalization of new products and indicators. Publish the updated *Minimalist OceanSITES Interdisciplinary Network (MOIN)* document (backbone network of minimalist identical multi-disciplinary sites) and hold a MOIN Workshop in early 2014 Work closely with other communities and attend meetings when appropriate. For example, • Hydrophone sites – LIDO • Ocean Tracking network • Deep Ocean initiative • INDEEP- Intern Network for scientific investigation of Deep sea ecosystems

	• Ocean Acidification, IOCCP Increase data holdings at the OceanSITES GDACs Finalization of OceanSITES data archive with NOAA's National Oceanographic Data Center (NODC). Formal archive to be functioning in early 2014. Participation in the Partnership for the Observation of the Global Ocean (POGO) meeting in Hobart in January and presenting a proposal for OceanSITES and POGO to play a role in working toward interoperability of sustained time series observing efforts in the ocean.

2 Deployment plans for 2013

There are 11 planned sites to be included in the OceanSITES network (Figure 1).

Acquisition of new deep ocean temperature/salinity instruments and determination of which existing OceanSITES will be added to the deep ocean temperature/salinity time series observing array.

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 25% of the OceanSITES array is exchanging data in real-time on the GTS. An additional 10% are exchanging data in real-time but have not yet begun GTS transmission.

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 1/3 of the members are providing data in this format and we hope to see this number increase in 2013-2014. However, most OceanSITES members are distributing data in other formats from sites in their own institution.

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

Annex (optional)

Status maps and graphics

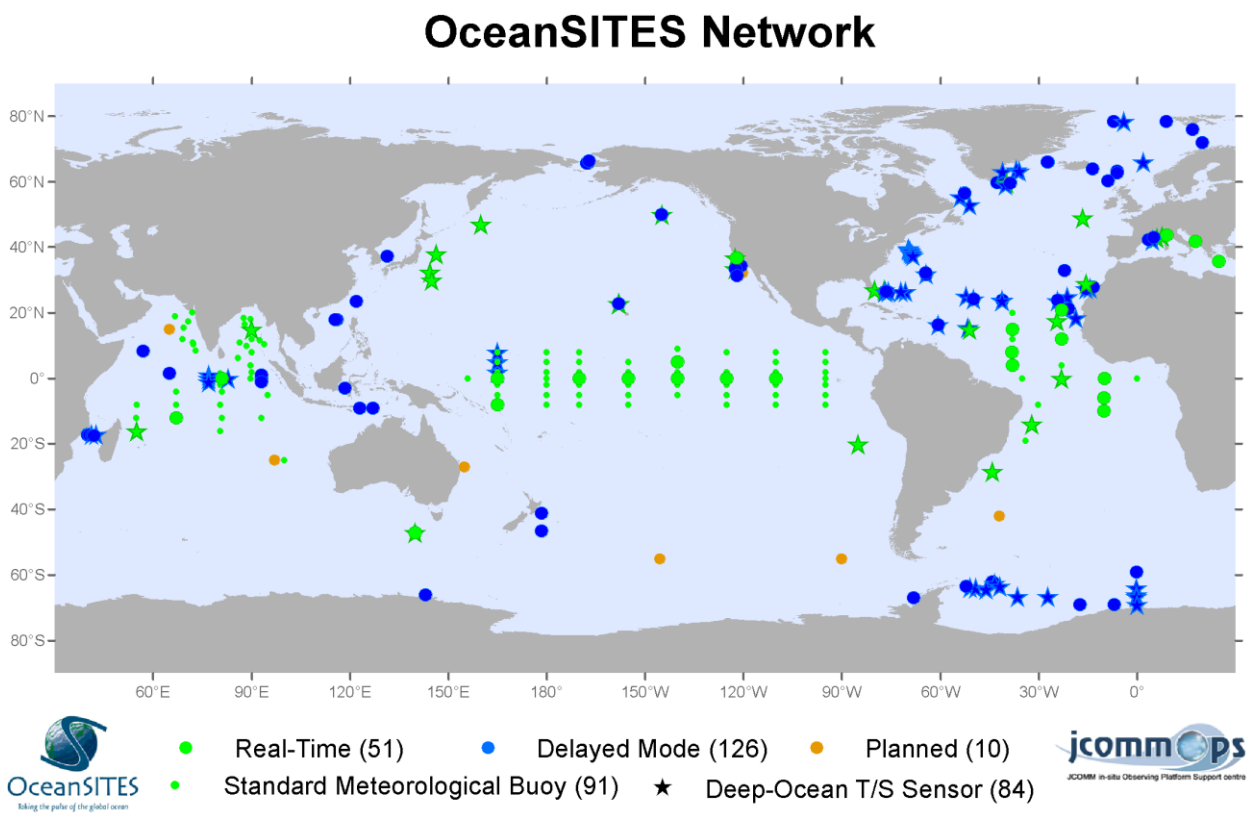


Figure 1 - Current status of the OceanSITES network (July, 2013).

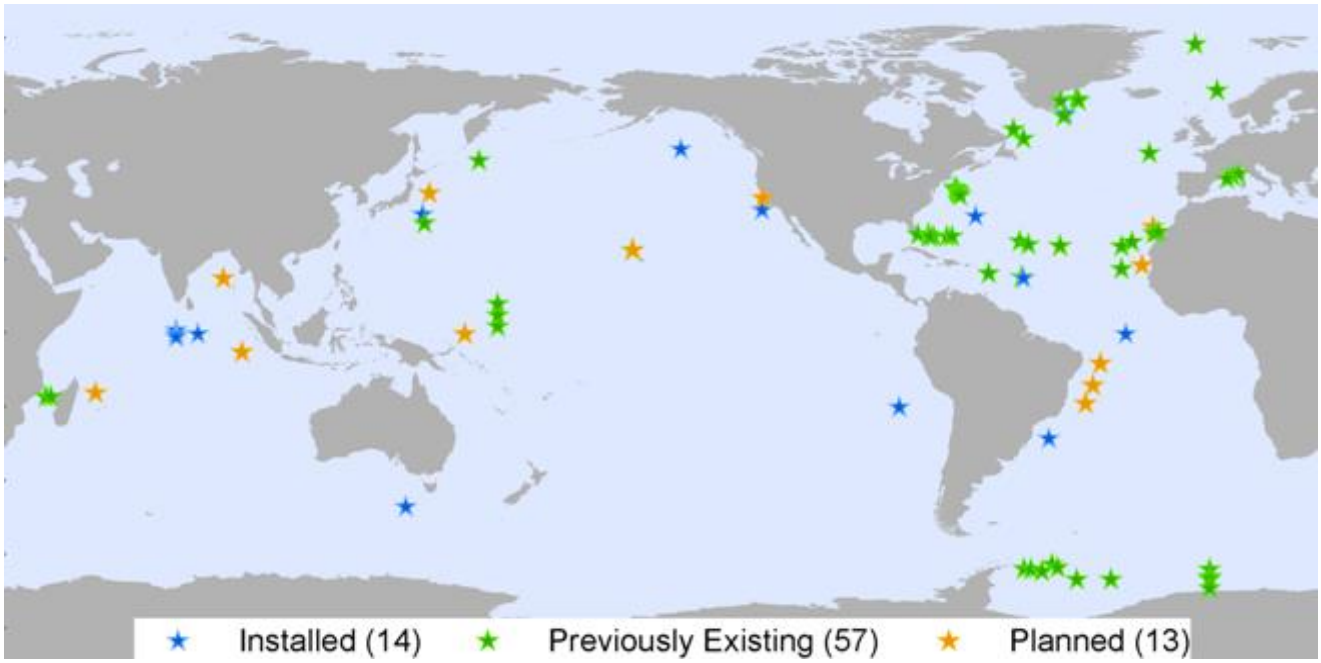


Figure 2 - Status of the deep-ocean temperature and salinity sensors.

REPORT BY THE INTERNATIONAL TSUNAMETER PARTNERSHIP (ITP)

(Report submitted by Richard Crout, NOAA/NDBC, USA)

1 Summary

Name of Action Group	The Tropical Moored Buoy Implementation Panel TIP
Date of report	31 July 2013
Overview and main requirements addressed	The Tropical Moored Buoys 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. A few moorings also have specialized instruments to measure turbulence dissipation. 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: 72 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), National Institute of Oceanography (NIO), Agency for the Assessment and Application of Technology (BPPT), Ministry of Marine Affairs and Fisheries (KKP), First Institute of Oceanography (FIO), Agulhas and Somali Current Large Marine Ecosystems (ASCLME), 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 2012/2013; and planned in 2013/2014)*	• PIRATA-17/TACE/TAV 10-14 September 2012, Kiel, Germany • CLIVAR/GOOS Indian Ocean Panel 9th Session 15-20 October, 2012, Capetown, South Africa • TIP Workshop, 23-24 October, 2012, Jakarta, Indonesia • CLIVAR/GOOS Indian Ocean Panel 10th Session 8-12 July, 2013, Li Jang, China • PIRATA-18/TAV 22-25 October 2013, Venice, Italy • Tropical Pacific Observing System Review, January 2014, location TBN
Current status summary *(July 2013)*	TAO/TRITON: 45 of 67 surface moorings reporting. PIRATA: 18 of 18 surface moorings reporting. RAMA: 18 of 26 surface moorings reporting.
Summary of plans for 2014	TAO/TRITON: Maintain 72 mooring array. PIRATA: Maintain 18 mooring array RAMA: Maintain 32 sites and add 2 more sites.

2 Deployment plans for 2014

The NOAA/NWS Tsunami Program holds no current plan to increase the density of NOAA owned buoys in the Tsunami warning network. The program has and plans to continue the engagement of international partners in 2014 and beyond as a means to optimize the worldwide network efficiency and effectiveness of its ocean warning buoys. NOAA plans to continue investigation in newer technology such as cabled near field instrumentation, mid-frequency recorders, and other surface expressions. To date, the DART II system remains deployed operationally at 39 NOAA owned stations. NOAA NDBC field tested a DART II system installed on a NDBC owned Liquid Robotics Inc. (LRI) Wave Glider with a Mid-Frequency Bottom Pressure Recorder at its station in the Gulf of Mexico in 2013. The system provided data from end to end successfully for several weeks.

India
Moored Tsunami Buoy Programme

National expert committee recommended to continue same network and no plan to increase. Efforts are being made to improve technology and increase interval of servicing considering constraints in ship time availability by In house discussions and sharing the experience with NOAA PMEL. Further Presently 2 SAIC buoys one each in Arabian Sea and Bay of Bengal are working and servicing was completed. NIOT assembled buoy with Sonar dyne BPR are working in 4 locations 3 in Bay of Bengal and one in Arabian Sea. However Arabian Sea buoys are serviced with support of armed guards as it is notified as piracy probe area Systematic technological advancements are leading to better performance of NIOT integrated tsunami Buoy systems which is using INMARSAT. NIOT has successfully developed the IDAS (Indigenous Buoy Data Acquisition System) for Tsunami Buoy. These systems are already deployed and working satisfactorily. The technology was transferred to an industry to meet further requirements.

Safety

The report fatal accident in tsunami buoy in Malaysia from Fugro Oceanor Norway was circulated through IOC. ITP can discuss on safe designed and handling of Tsunameter during the meeting

3 Data management

3.1 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 Centers (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 watch-standers. Indian tsunami buoy data sets are delivered to Indian Ocean Tsunami Warning Centre INCOIS

3.1.1 Data policy

Details on data exchange policy -- 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. 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). Two SAIC data are shared and NIOT buoy data will be shared

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.

3.1.3 Delayed mode data exchange

The US recovers and analyzes the data recovered from BPR flash storage. Short durations of high resolution data can be recovered via two way iridium communications if requested by TWCs.

3.2 Data quality

The NDBC publishes its *Handbook of Automated Data Quality Control Checks and Procedures* on its website; specifically, at the following URL:
http://www.ndbc.noaa.gov/NDBCHandbookofAutomatedDataQualityControl2009.pdf

4) Instrument practices

The NDBC will share details on best practices and processes used to ensure traceability and accuracy with users. The NDBC is identified as a Regional Marine Instrumentation Center (RMIC) and has conducted several international meetings on this topic at its Stennis Space Center, Mississippi facility.

NIOT India follows best of practices and methods to ensure accuracy in provided data to users

5) Other issues as needed

None at this time.

Annex
Status maps and graphics

Global Tsunameter Network								
Country	Planned Network	Currently Operational	Tsunameter Types	Local Reception	Data to GPS	Data to FTP	Data Formats	Vandalized Stations
Australia[1]	9	4	SAIC - STB SAIC - ETD	Yes	Yes	No	NOAA-DART BUFR/CREX	-
Chile	3	2	SAIC - DART - II SAIC - STB	Yes	Yes	Yes	NOAA-DART	-
China	2	1	DART - STB	Yes	No	No	NOAA-DART BUFR	1
Ecuador	2	?	Sonardyne	Yes	Yes	Yes	NOAA-DART	-
India	7	6	SAIC-STB IndianBuoy-Sonardyne	Yes	Yes INCOIS	No	BUFR/CREX	-
Indonesia	14	-	InaBuoy SAIC-ETD	Yes	No	No	Local Format NOAA-DART	-
Japan	6	3	SAIC-STB	Yes	Yes	No	CREX	-
Malaysia	3	-	-	Yes	No	No	-	-
Republic of Korea	2	-	-	-	-	-	-	-
Russia	3	1	SAIC-STB SAIC-ETD	No	Yes	Yes	NOAA-DART	-
Thailand	3	1 2	SAIC-STB Environtec	No Yes	Yes Yes	Yes No	NOAADART -	No No

1 The full Australia ITP Report can be found at http://jcomm.info/australia_itp_2013

USA	39	31	DART - II	Yes	Yes	Yes	NOAA-DART	0

Annexure ITP
Technological developments

Current Status and summary

DART 4th Gen (DART 4G): Measuring and Reporting Tsunamis as the Earthquake is Rupturing

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NOAA-Pacific Marine Environmental Laboratory (PMEL)
Director of Engineering
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206-526-6149
Draft: July 31, 2013

Synopsis

Recent advancements in sensors, software and power management hold promise that detection and measurement of near-field tsunamis with unprecedented resolution is now possible. This improved nano-resolution pressure sensor and algorithm will allow the separation of the tsunami signal from the earthquake "noise." The NOAA DART (Deep Ocean Assessment and Reporting of Tsunamis) 4G design builds on the DART-ETD (Easy-to-Deploy), which consists of a surface buoy connected to a subsurface tsunameter via an acoustic link. Real-time communications latencies from seafloor-to-shore have been reduced, while high-resolution tsunami height measurements have been increased. Successful laboratory testing of the sensor and algorithm has progressed and ocean testing is in the planning stages to demonstrate and validate the new DART design.

System Description

The DART 4G System is an enhanced version of DART-ETD technology developed at NOAA-PMEL (Bernard and Meinig, 2011) that has been transitioned to industry (Lawson et al., 2011). An early prototype was deployed for 18 months on the Monterey Accelerated Research System (MARS) cabled observatory at a depth of ~900 m. Numerous earthquakes and far-field tsunamis were captured and compared to a co-located standard DART tsunameter as well as nearby seismometers (Paros et al., 2011).

The enhancements include a new pressure sensor and software that run a PMEL detection and filter algorithm to transmit tsunami height data while the earthquake is rupturing. The new algorithms have been developed by studying near-field tsunami data and applying the most effective techniques. Advancements in power management allow for a system endurance of three years for the tsunameter and two years for the surface buoy. Shore-side software has also been upgraded to receive the higher-frequency observations during events. Additionally, component obsolesence issues have been addressed in the entire system and will be field tested in 2013.

Industry

Sonar dyne
Sonardyne has deployed a tsunameter for Ecuador deployments and showed very good data availability Further 6th generation Compatt-based BPR which has been deployed for nearly 12 months and has been used with WaveGlider.

SAIC

SAIC's efforts to modularize and enhance cross-compatibility of SAIC Tsunami Buoy (STB) and SAIC Easy-to-Deploy (ETD) DART systems along with improvements to electronics and buoy

design has resulted in increasing high levels of reliability. Discounting two occurrences where moorings were cut by vandalism, system reliability for the entire deployed fleet of SAIC systems increased from 95% in 2012 to 98% in 2013. SAIC delivered its 27th and 28th systems and has three additional systems in production, two are ETD DART systems which will be delivered to Australia this fall. Three new STB Mid-Frequency (MF) systems are performing well in the challenging waters off the east coast of Japan, and a new STB system is now operating off Chile joining its other STB based system. Both India STB systems and the Thai STB have undergone system refresh this year and continue to provide excellent data in the Bay of Bengal and Arabian Sea. Russia will be adding an ETD DART and STB system in the Northwest Pacific, with deployments planned for the summer of 2014.

International Tsunameter Partnership

Draft -Terms of Reference

Tsunameters are instruments that measure tsunamis in the open ocean. To deliver tsunami measurements in real-time requires that a tsunameter be coupled to a highly sophisticated communication system to report the passage of tsunami in deep ocean waters to tsunami warning centers. For the purposes of this Terms of Reference, a tsunameter is a real-time reporting tsunameter. In the aftermath of the Indian Ocean tsunami of 26 December 2004 a number of countries have announced national plans to operate tsunameters or increase the number of tsunameters they operate in pursuit of our common goal of preserving lives and property. Tsunameters are critical to the rapid detection and forecast of tsunami

TOR

1. To establish, coordinate and support international tsunameter research and development efforts, including joint activities;
2. To set common tsunameter standards, including performance standards and testing and calibration protocols, to ensure that designers and operators of tsunami warning systems can rely on the consistency, comparability and availability of tsunameter data to the maximum extent possible;
3. To provide input as appropriate to sea level observation network design with a view to optimizing the contribution of tsunameter instruments to the operational and cost effectiveness of tsunami warning systems;
4. To maximise the sharing of tsunameter technology and cooperation among members and with suppliers of tsunameter equipment and components to achieve secure global supplies of high quality systems;
5. To maximise opportunities for coordination and cooperation with regards to ship access, deployment, operation, maintenance and support of tsunameter systems; and
6. To help build capacity among members to accelerate the viability and success of regional tsunami warning systems.