INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

WORLD METEOROLOGICAL ORGANIZATION

DATA BUOY COOPERATION PANEL

DBCP-XXIV/Doc. 8
(10.IX.2008)

TWENTY-FOURTH SESSION

ITEM: 8

CAPE TOWN, SOUTH AFRICA
13-16 OCTOBER 2008

ENGLISH ONLY

REPORTS BY THE ACTION GROUPS

(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 be invited to comment, and particularly make decisions or recommendations, as appropriate on the following topics:

(a) Note and comment on the information contained in this document; and

(b) Take into account the contents of the report when discussing relevant agenda items.

Appendices:
A. Report by the Global Drifter Programme (GDP);
B. Report by the Tropical Moored Buoy Implementation Panel (TIP);
C. Report by the EUCOS Surface Marine Programme (E-SURFMAR);
D. Report by the International Buoy Programme for the Indian Ocean (IBPIO);
E. Report by the DBCP-PICES North Pacific Data Buoy Advisory Panel (NPDBAP);
F. Report by the International Arctic Buoy Programme (IABP);
G. Report by the WCRP-SCAR International Programme for Antarctic Buoys (IPAB);
H. Report by the International South Atlantic Buoy Programme (ISABP); and
I. Report by the Ocean Sustained Interdisciplinary Timeseries Environment observation System (OceanSites).

REPORT BY THE GLOBAL DRIFTER PROGRAMME (GDP)

Rick Lumpkin and Mayra Pazos, NOAA / AOML
Shaun Dolk and Erik Valdes, University of Miami / CIMAS

1. PROGRAM OVERVIEW

The Global Drifter Program (GDP) is the principle component of the Global Surface Drifting Buoy Array, a branch of NOAA's Global Ocean Observing System (GOOS) and a scientific project of the DBCP. Its objectives are to: 1. Maintain a global 5 x 5 degree array of 1250 ARGOS-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 inter-annual) climate predictions as well as climate research and monitoring.

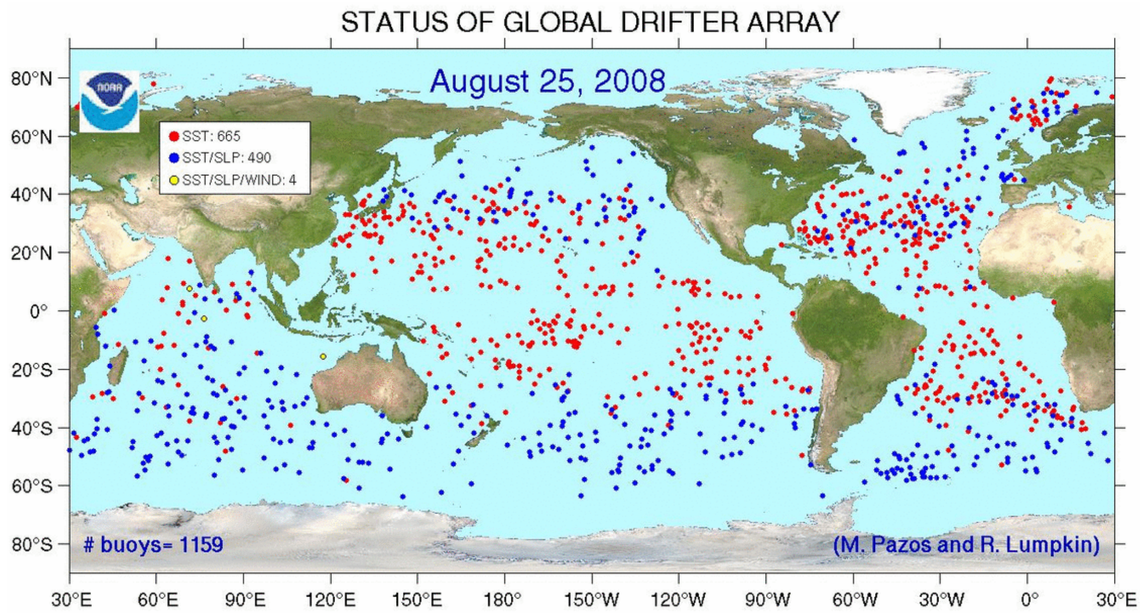
The GDP is managed with close cooperation between: Manufacturers in private industries, who build the drifters according to closely monitored specifications; NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML), which coordinates deployments, processes the data, archives the data, maintains META files describing each drifter deployed, develops and distributes data-based products, and updates the GDP website (http://www.aoml.noaa.gov/phod/gdp.html); and NOAA's Joint Institute for Marine Observations (JIMO), which supervises the industry, upgrades the technology, purchases drifters, and develops enhanced data sets.

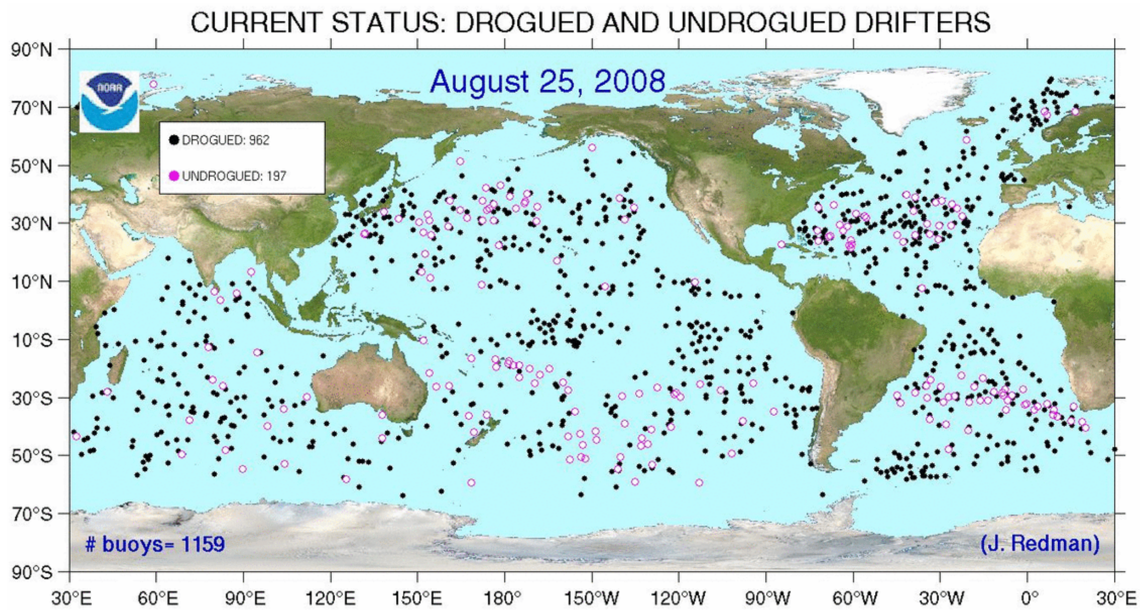
Drs Peter Niiler (JIMO) and Rick Lumpkin (AOML) maintain liaisons between the GDP and individual research programs that deploy drifters. AOML's component of the GDP is directed by Rick Lumpkin and is composed of the Drifter Operation Center (DOC) and the Data Assembly Center (DAC).

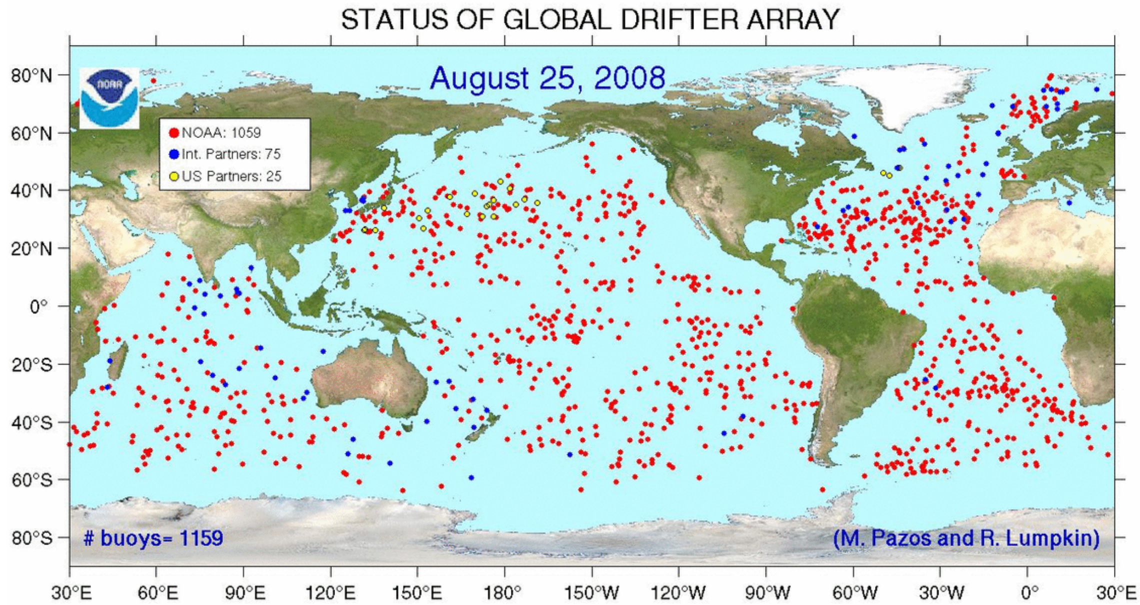
In order to fulfil its objectives, the GDP determines areas of interest, locates Vessels of Opportunity (VOS) which help deploy buoys while in transit), coordinates deployment locations, processes and archives data, develops and distributes data-based products and posts all quality controlled results on the GDP website. Within these daily activities, the GDP works closely with various companies and institutions.

2. CURRENT STATUS OF THE GLOBAL DRIFTER ARRAY

As of 25 August 2008, the global array of GDP drifters was at 1159, with 962 (83%) drogued to measure mixed layer currents.


STATUS OF GLOBAL DRIFTER ARRAY
August 25, 2008
SST: 665
SST/SLP: 490
SST/SLP/WIND: 4
buoys= 1159
(M. Pazos and R. Lumpkin)
80°N
60°N
40°N
20°N
0°
20°S
40°S
60°S
80°S
30°E 60°E 90°E 120°E 150°E 180° 150°W 120°W 90°W 60°W 30°W 0° 30°E

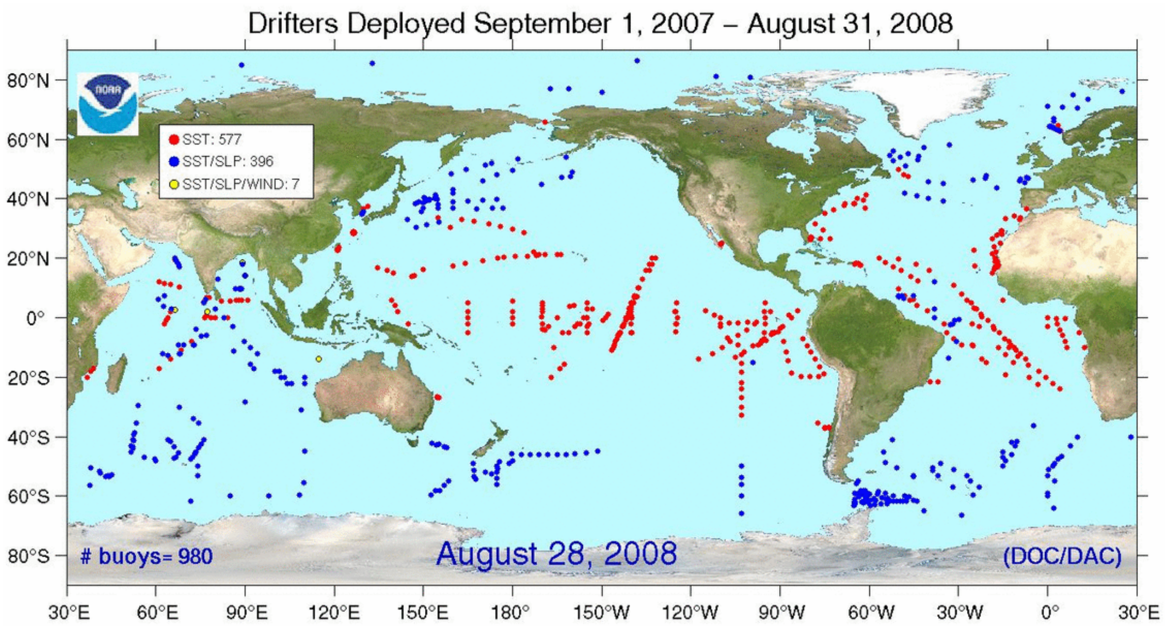

CURRENT STATUS: DROGUED AND UNDROGUED DRIFTERS
August 25, 2008
DROGUED: 962
UNDROGUED: 197
buoys= 1159
(J. Redman)
90°N
70°N
50°N
30°N
10°N
10°S
30°S
50°S
70°S
90°S
30°E 60°E 90°E 120°E 150°E 180° 150°W 120°W 90°W 60°W 30°W 0° 30°E


STATUS OF GLOBAL DRIFTER ARRAY
August 25, 2008
NOAA: 1059
Int. Partners: 75
US Partners: 25
buoys= 1159
(M. Pazos and R. Lumpkin)
80°N
60°N
40°N
20°N
0°
20°S
40°S
60°S
80°S
30°E 60°E 90°E 120°E 150°E 180° 150°W 120°W 90°W 60°W 30°W 0° 30°E

3. OPERATIONS: 2008 SUMMARY, 2009 PLANS

2008 Drifter Deployments

In FY2008 (1 September 2007 to 31 August 2008), there were a total of 980 drifters deployed, falling 20 drifters short of the goal of 1000 deployments. When these deployment totals are compared to that of the deployments from last year, there were 23 fewer buoys deployed, bringing the total number of drifters on the GTS to 1179. Last year at this time, 1003 drifters had been deployed with 1215 transmitting on GTS.



Of the 980 drifters deployed in FY2008, a total of 137 were classified as research drifters (Consortium Research). The breakdown of all 2008 deployments is:

North Atlantic:	127
Tropical Atlantic:	147
South Atlantic:	116
North Pacific:	73
Equatorial Pacific:	316
South Pacific:	45
Indian Ocean:	156

Total # drifters
Deployed in FY2008: 980

2009 Deployment Plan

Operation Buoy Deployments 800

Consortium Research Buoy Deployments	200
Total Deployments in 2009	1000

Being that FY2009 is a continuation of the International Polar Year, there is a strong desire to maintain the awareness of sea surface temperature, barometric pressure and ocean currents in the higher latitudes (>40°). Historically, these areas have been sampled with less regularity, thus creating a need to increase the number of drifters deployed in these regions.

In FY2008, there were a total of 326 buoys deployed in areas with a latitude greater than 40°. When we break down these deployments by region, one can see that the distribution between North and South is similar.

North Atlantic (greater than 40°N):	110	}	130 Northern Deployments >40°N
North Pacific (greater than 40°N):	20		39.9%
South Atlantic (greater than 40°S):	112		
South Pacific (greater than 40°S):	39	}	196 Southern Deployments >40°S
South Indian (greater than 40°S):	45		60.1%

Taking a closer look at the type of buoys deployed; of the 326 buoys at latitudes greater than 40°, a total of 276 of these buoys were SVPB's (84.7%), 48 were SVP's (14.7%), and 2 were SVPBS's (00.6%).

The total of 326 buoys deployed falls 49 shy of the 2008 goal of 375 buoys in regions with latitude greater than 40°. While the total number of buoy deployments in these regions remained the same, the percentage of SVPB buoys deployed increased from 55.7% to 84.7%, which easily surpassed this year's goal of 60%.

With invaluable assistance and collaboration from GDP's numerous partners throughout the world, the goal is to increase the number of high latitude deployments to 375 buoys in 2009, while maintaining the percentage of SVPB deployments above 80%.

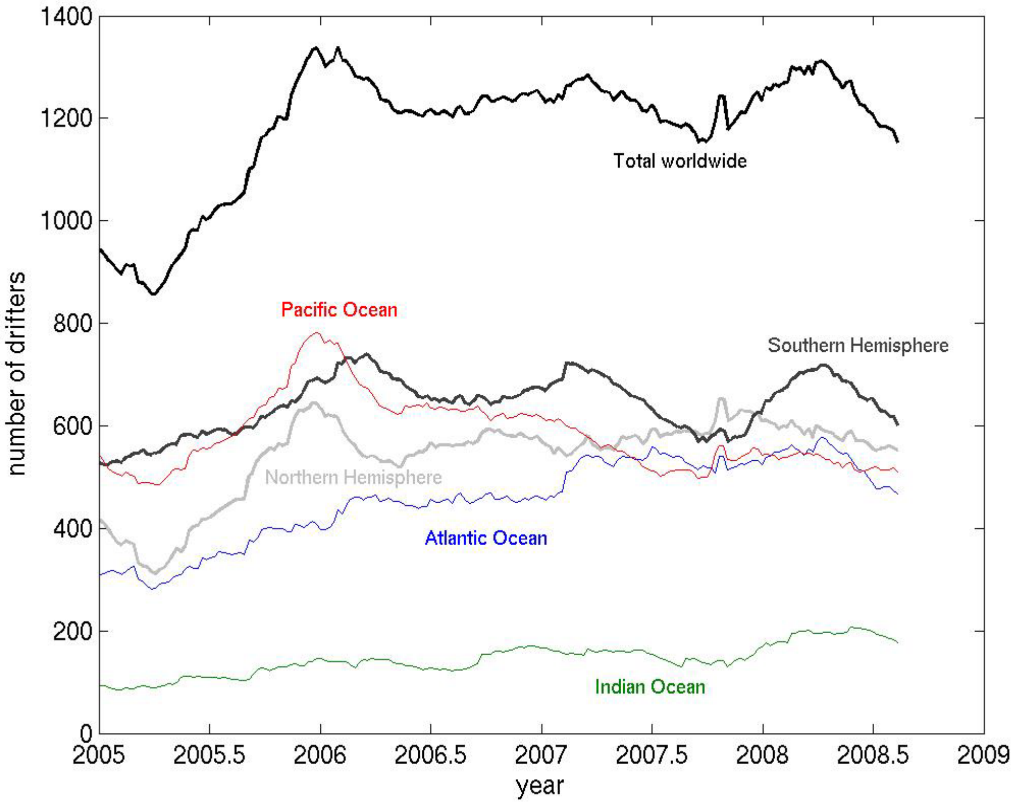
Deployment highlight: African Partnership Station (APS) Training

In March of 2008, 28 participants from Ghana, Cameroon, and Nigeria boarded the U.S. Navy vessel HSV-2 *Swift,* where three days of training ensued from the port of Tema, Ghana. The ability of the U.S. Navy to host the training aboard one of its vessels allowed for a novel "hands-on" experience which enabled participants to become familiar with the instruments, from which the data they are studying. The session was conducted as part of the U.S. Naval Forces Africa Partnership Station (APS), which is an initiative in support of NOAA's climate research and ocean-observing efforts. During the three-day session, one Argo Float, three global drifting buoys, and 12 expendable bathythermographs (XBT's) were deployed from the HSV-2 *Swift* to gather temperature, salinity, and current measurements. The deployment of these instruments was an important step in understanding how to incorporate the data access training previously taught in Ghana and Belgium.

Data from the instruments are transmitted via satellite to the Global Telecommunication System (GTS) for use by the international oceanographic and meteorological communities in ocean and climate studies, weather modeling, and marine operations. As the network of West African regional partners develops, it is anticipated that a greater number of ocean-observing instruments will be deployed in the area, leading to improved short and long-term climate predictions.

4. ANALYSIS OF THE GLOBAL DRIFTER ARRAY

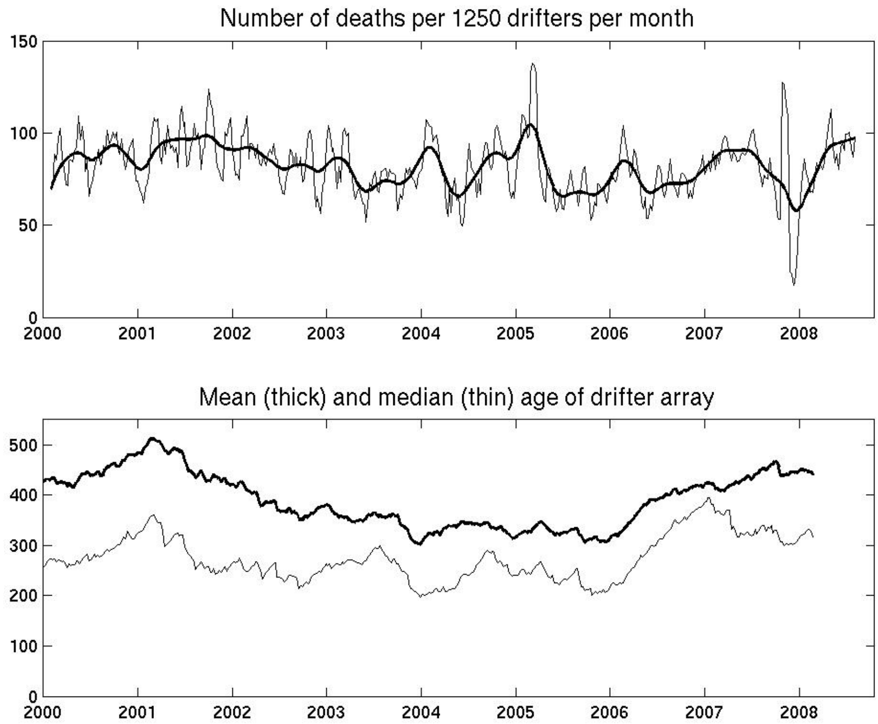
The number of drifters in the global array is shown below. The array reached its goal of 1250 drifters in September 2005, and subsequently has fluctuated around that average by design. Those fluctuations reveal a distinctly seasonal pattern, with peaks of 1300—1350 drifters in Boreal winter—spring and troughs of ~1150—1200 drifters in summer—fall. Such patterns reflect the seasonal variations in deployment opportunities, primarily due to dense Southern Ocean deployments during the research campaign season there.



Size of global drifter array in regions. Atlantic / Indian divided at 25°E in the Southern Ocean, Atlantic / Pacific at 70°W in the Southern Ocean, Indian / Pacific at 125°E south of Timor.

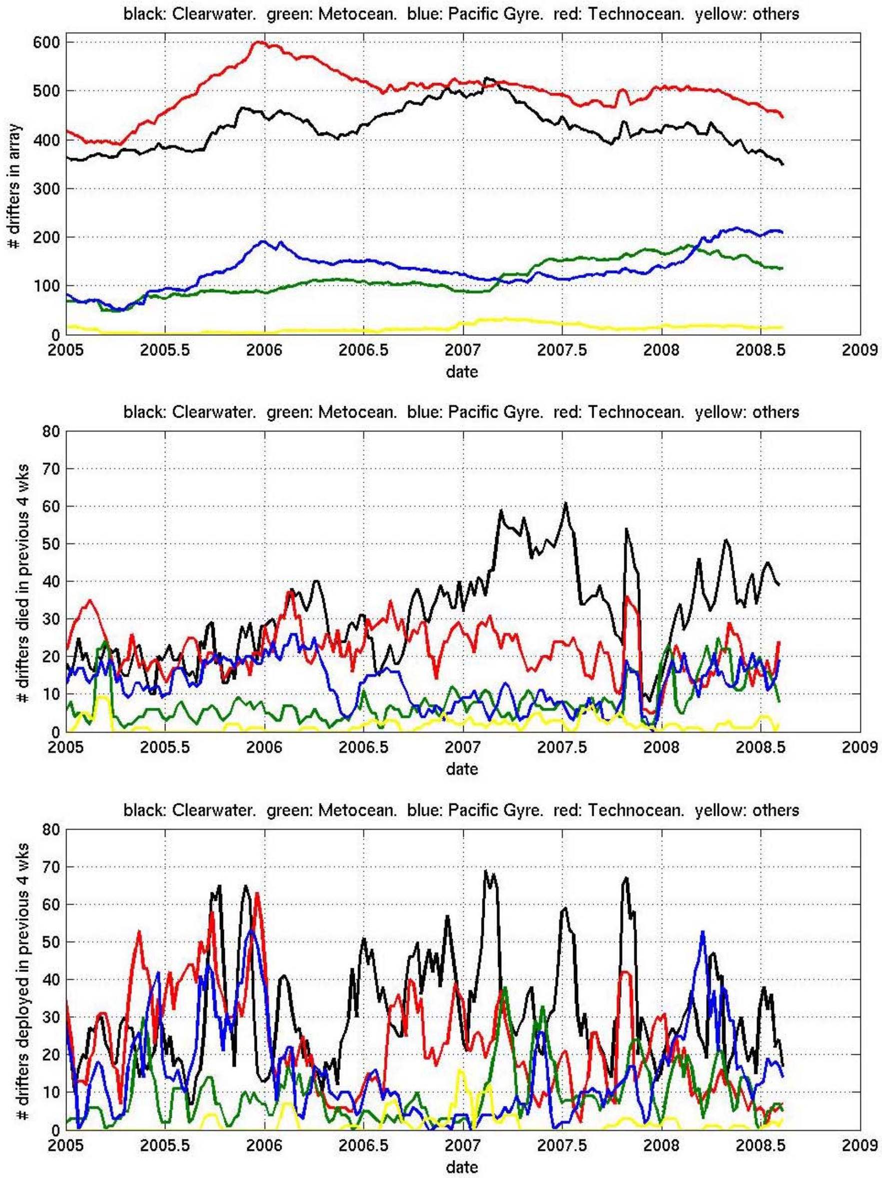
The number of drifter deaths per month, per 1250 drifters, is shown below. This is the number of drifters that must be deployed each month in order to maintain the array at 1250. The death rate has increased over the last few years, with a trend from September 2005 to now increasing from 71 to 85 deaths per month. At an approximate cost of $1500 per drifter (SVP, neglecting the additional costs of barometer upgrades), an additional 14 deaths per month is equivalent to an additional $252K per year to maintain the drifter array.

One major factor in setting the high death rate is the mean age of the array, also shown below. During 2005, the size of the array increased dramatically as deployments were ramped up to meet the goal of 1250 drifters by September. This large influx of new drifters drove down the average age of the array to its lowest level in years. At the beginning of 2006, the median age of a drifter in the array was 200 days, far less than the operational lifetime of 450 days. However, maintaining ~1250 drifters requires fewer deployments, and the mean age of the array increased after January 2006. The mean age is now near 450 days, e.g., the mean lifetime of a drifter, suggesting that the increase in death rate and array age should level off unless systematic engineering problems develop to reduce the mean age of the array while increasing the death rate.



Number of drifter deaths per 1250 drifters per month (top) and the age of the global drifter array (bottom).

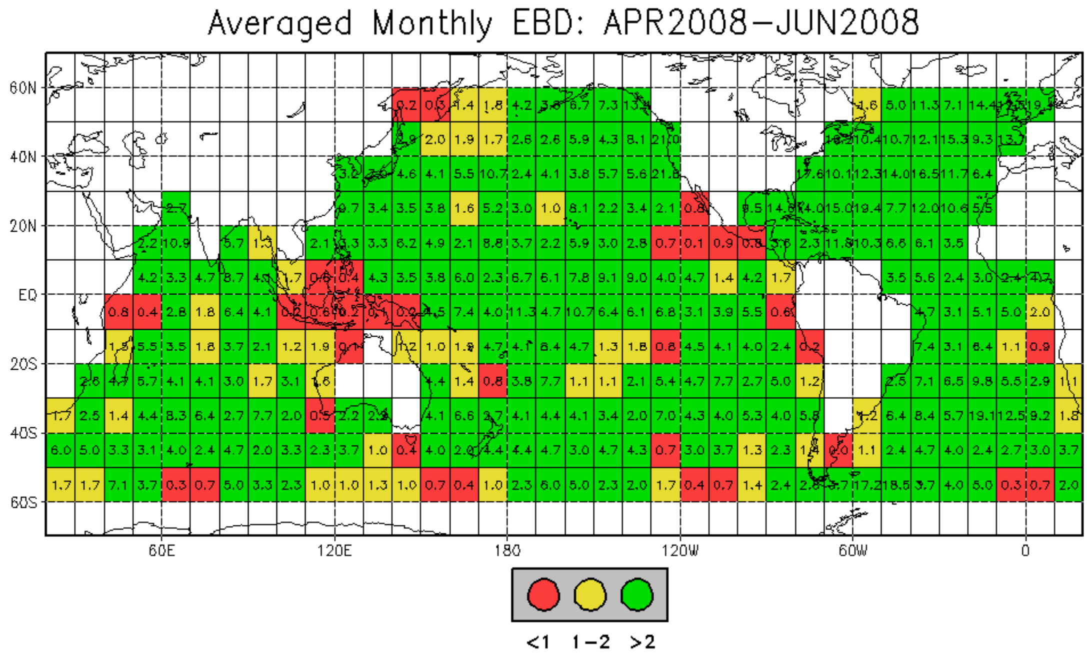
Finally, the figure below shows the recent growth of the array as a function of the four major drifter manufacturers. The array is dominated by drifters from Technocean and Clearwater. Death rates (second sub-plot) have remained relatively low and steady for Technocean drifters. Clearwater drifter deaths spiked to larger values in early to mid 2007, an issue which the GDP identified in mid-2007 and communicated to the manufacturer. Since mid-2008, the death rates of three of the four manufacturers (all but Technocean) have risen, perhaps reflecting the increasing age of the drifters. For the period September 2007 to the present, the mean death rate, per 1250 drifters, per month have been 108 (Clearwater), 89 (Metocean), 84 (Pacific Gyre) and 52 (Technocean). Some of these variations reflect various deployment regions, which are not uniform for drifters from the manufacturers, deployment techniques from individual platforms, storage times for some batches of drifters, etc.; these variations motivated the ADB study described earlier.



Size of the array divided into the four major manufacturers (top), the number of drifters that died each month (middle) and the number of drifters deployed each month (bottom).

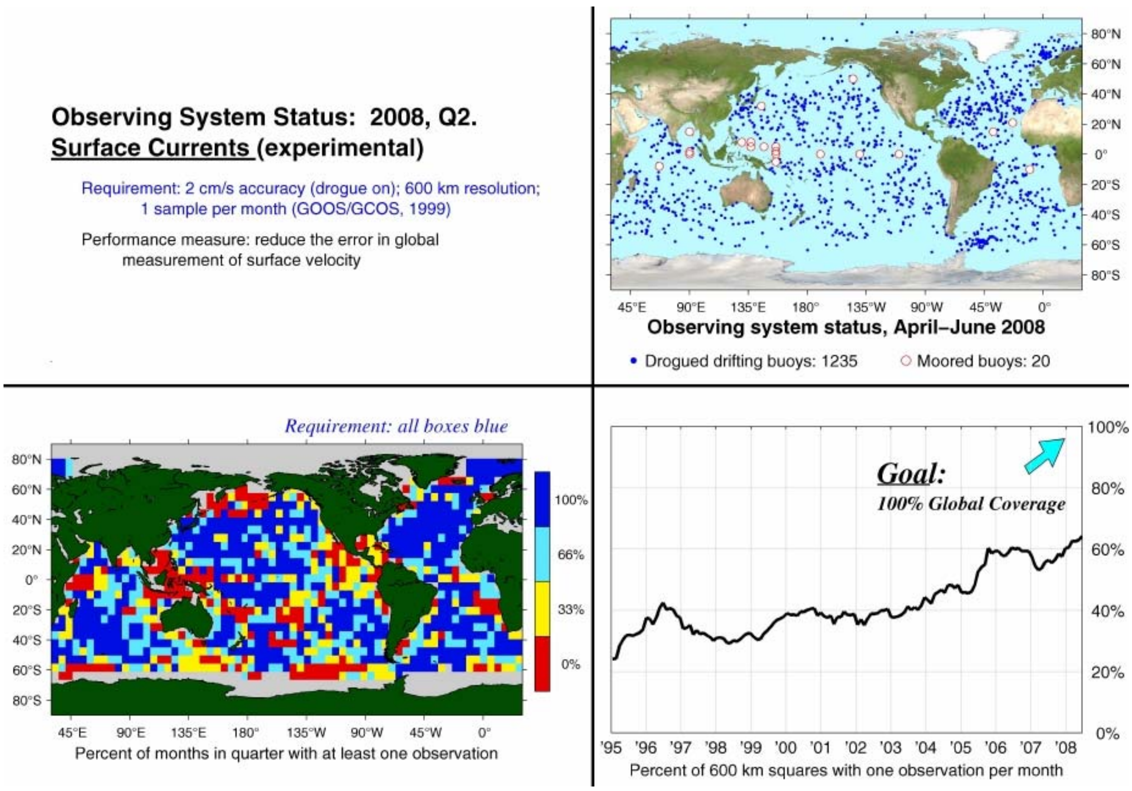
Evaluating the overall observing system for SST and ocean current measurements

The overall Global Ocean Observing System (GOOS) is evaluated for SST measurements by NOAA's National Climate Data Center (NCDC), and for near-surface current measurements by the Global Drifter Program. SST measurements are quantified by Equivalent Buoy Density (EBD), which downweighs ship measurements compared to moored and drifting buoy measurements to reflect the relative accuracy levels. Most of the spatial coverage of the array is due to drifters, which fill the vast gaps between the major shipping lines, although moored buoys are invaluable for maintaining instrumentation in regions of surface divergence. Recent maps (see below) indicate that EBD is lowest in shallow, near-coastal and ice-covered regions.



Equivalent buoy density (EBD) for April - June 2007. Figure courtesy Huai-min Zhang, NOAA / NCDC.

Near-surface currents are measured by moored current meters and by drogued drifters, a subset of the overall drifter array due to drogue loss. Over the most recent quarter, slightly over 60% of all 5 x 5 open-ocean squares were sampled at least once. Spatially (Fig. 2.2, bottom left), coverage is best in the Atlantic Ocean and southern Indian Ocean, with lowest coverage in the South Pacific, northwestern North Pacific and western tropical Indian Ocean.



GOOS measurements of near-surface currents for April - June 2008 (NOAA / GDP).

5. DRIFTER QUALITY EVALUATION

AOML Data Buoy (ADB) Comparison Study

This year, as in 2005 and 2006, the GDP is conducting an AOML Data Buoy (ADB) comparison study. During this study, drifters from four different buoy manufacturers (Clearwater Instruments Inc., Metocean Data Systems Ltd., Pacific Gyre Inc., and Technocean Inc.) are deployed in clusters in various regions throughout the world. The clusters are initially only a few meters apart, allowing us to cross-compare for SST quality and wind-driven slip. It is the goal of the GDP to evaluate the performance of each product independently, and use these findings to determine the strengths and weaknesses (if any) that exist.

Preliminary results show that after five months of data collected, a total of four drifters out of 20 have already ceased transmitting, one from Technocean after 50 days, two from Metocean after 34 and 64 days and one from Pacific Gyre after 91 days. GDP is concerned about the rapid death of the Metocean drifters, with two out of five dead already dead, and will continue to monitor the lifetimes of the remaining drifters.

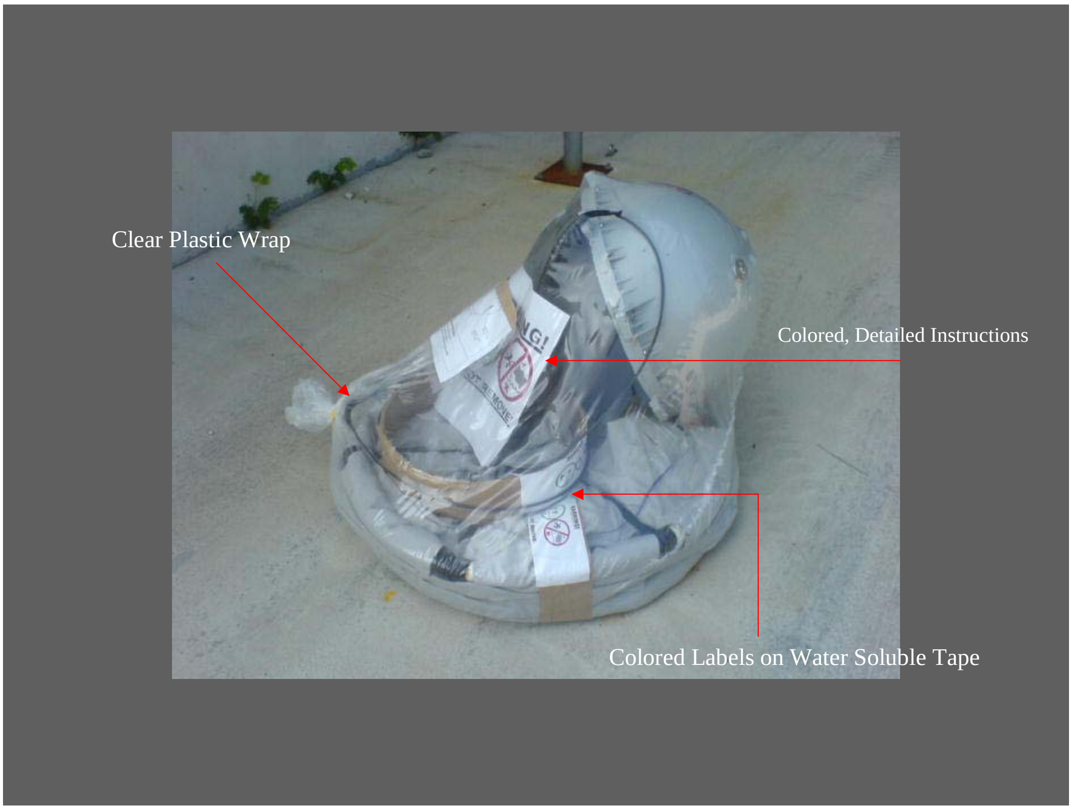
Five ADB drifters have already lost their drogues: one Clearwater drifter lost its drogue after 99 days, three Technocean drifters lost their drogues after 101, 99 and 75 days, and one Pacific Gyre showed drogue lost after only 12 days in the water. GDP is also concerned with the rapid loss of Technocean drifters, and will monitor this issue more closely in the Bay of Biscay study (see below).

With respect to SST, GDP has found two problems with Pacific Gyre drifters: one had an offset of 0.45°C with respect to its neighbours (confirmed not to be an error with the SST coefficients) … this offset was added to the GTS distribution to correct and avoid wrongful data dissemination; another drifter from Pacific Gyre had SST sensor failure after 30 days in the water. Also one Metocean drifter’s SST failed five days after deployment.

As a subset of the 2008 ADB Comparison Study, five SVPB drifters each from three manufacturers (Clearwater, Pacific Gyre, and Technocean) have been chosen to evaluate the addition of strain gauge for drogue detection. These drifters will be deployed in tight clusters in the Bay of Biscay. As well as testing the sensors, the GDP and Météo-France are taking this opportunity to examine other aspects of these drifters, such as barometer port sensors, SST values, battery life, signal strength, etc.

The results of these studies are intended to increase performance, longevity, and data quality, which will benefit the entire drifter community.

Finally, the GDP would like to reiterate the importance of the packaging of these drift buoys. Safety is a major concern for all who are involved in this project and every precautionary measure should be taken to ensure this point. One of the easiest ways to promote safety is to educate the individuals who are deploying and handling these instruments. Though a drift buoy is harmless, when it ends up in the hands of someone who has never seen one, GDP wants them to know how to handle it. The way to educate people how to deploy (and handle) these instruments is to have detailed instructions that explain proper usage. Ideally, the GDP would like to see all buoys wrapped in clear plastic, contain detailed (<u>colored</u>) instructions on the outside of the wrapping and (<u>colored</u>) labels on water soluble tape that indicates the proper deployment techniques. It is the belief of the GDP that taking these measures will maximize safety.



6. RESEARCH EFFORTS

In addition to composing a sustained part of the Global Ocean Observing System, drifters are a critical part of a number of ongoing research efforts. Here GDP highlights some recent studies; many more are routinely cited in the scientific literature. For a full list, see the GDP references at http://www.aoml.noaa.gov/phod/dac/gdp_biblio.html.

Global analysis of high frequency drifter motion

Since the introduction of multi-satellite processing in January 2005, the mean temporal resolution of drifter data has decreased dramatically from its earlier values, now averaging slightly over one fix per hour. This increase in temporal resolution allowed a global census of high-frequency (inertial and superinertial) motion (Elipot and Lumpkin, 2008). The rotary (clockwise and counter-clockwise) energy spectrum of hourly drifter velocity (Fig. 6.1) reveals the energy content in the anticyclonic inertial band and in semidiurnal and diurnal motion. The energy content in the inertial band is much higher here than in analyses of kriged data at high latitudes, where kriging to ¼ day values removes much of the inertial variance.

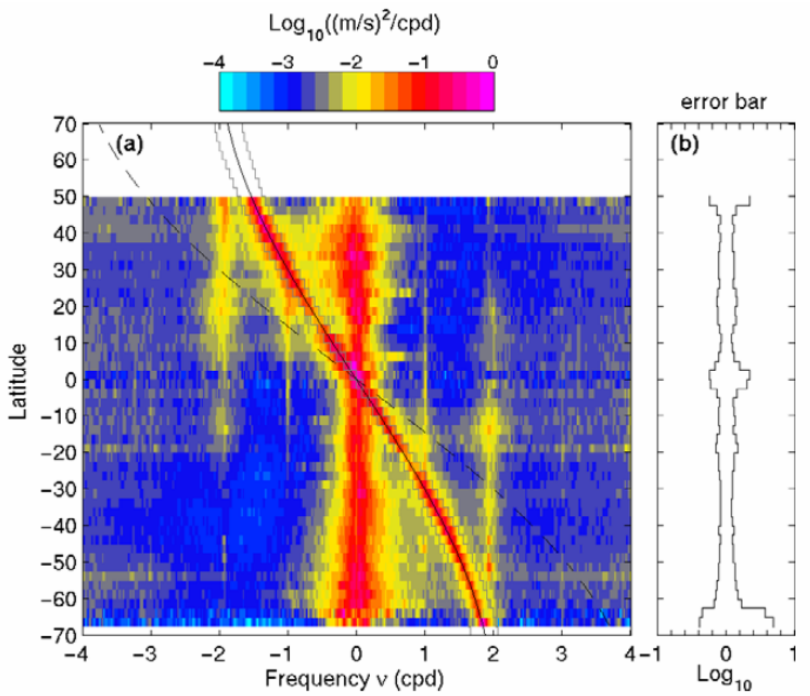


Fig. 6.1: Clockwise (negative frequency) and counter-clockwise (positive frequency) energy content in drifter velocities as a function of latitude, in the Pacific Ocean (from Elipot and Lumpkin, 2008). The local inertial frequency is indicated by the solid curve, twice the inertial frequency by a dashed curve. Diurnal and semidiurnal ridges of enhanced energy are seen at frequencies of ±1 and ±2 cycles per day.

Resolving these high-frequency motions has significant climate implications, as wind energy input as near-inertial waves is one of the primary energy inputs to drive the observed stratification of the ocean via interior ocean mixing (Munk and Wunsch, 1998). In another study (Chaigneu et al., 2008), the distribution of observed inertial energy (currents from drifters, mixed layer depths from Argo floats) was compared to predictions from a simple slab model (Fig. 6.2). The dramatic disparity indicates that existing estimates of wind energy input may be significantly in error.

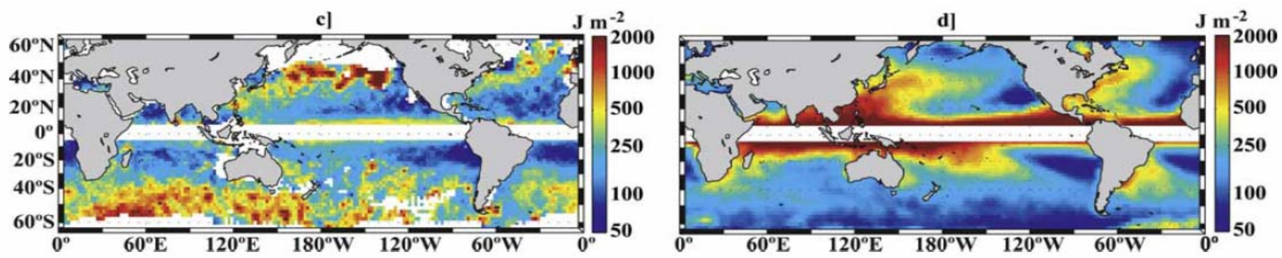


Fig. 6.2: Observed (left) and simulated (right) energy in the inertial band (from Chaigneu et al., 2008).

REFERENCES:

Chaigneau, A., O. Pizarro, and W. Rojas, 2008: Global climatology of near-inertial current characteristics from Lagrangian observations, *Geophys. Res. Lett.*, **35**, L13603, doi:10.1029/2008GL034060.

Elipot, S. and R. Lumpkin, 2008: *Geophys. Res. Lett.*, **35**, L05606, doi:10.1029/ 2007GL032874.

Munk, W. H. and C. Wunsch, 1998: Abyssal Recipes II: Energetics of tidal and wind mixing. *Deep-Sea Res.*, **45**, 1978-2010.

REPORT BY THE TROPICAL MOORED BUOY IMPLEMENTATION PANEL (TIP)

TAO / TRITON

The Tropical Atmosphere Ocean / Triangle Trans-Ocean Buoy Network (TAO / TRITON) moored buoy array is a central component of the ENSO Observing System, deployed specifically for research and forecasting of El Niño and La Niña. The Array consists of 55 ATLAS moorings maintained by the National Data Buoy Center (NDBC) and the Pacific Marine Environmental Laboratory (PMEL), 12 TRITON moorings maintained by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), and five sub-surface Acoustic Doppler Current Profiler (ADCP) moorings (four maintained by NDBC and one by JAMSTEC). In addition to these core moorings, there are several moorings deployed as enhancements, including 3 TRITON moorings in the far western tropical Pacific along 130 E and 137 E, and test sites maintained by NDBC for mooring refresh development.

At present (7 August 2008), ENSO-neutral conditions prevail in the tropical Pacific, with tropical Pacific sea surface temperature anomalies generally less than 0.5ºC, with anomalies greater than +1.0ºC only in the far eastern equatorial region. Wind anomalies were also small over the tropical Pacific. The most recent (7 August 2008) EL *NIÑO / SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION* issued by NOAA's Climate Predication Center states that "ENSO-neutral conditions are expected to continue through the Northern Hemisphere Fall 2008".

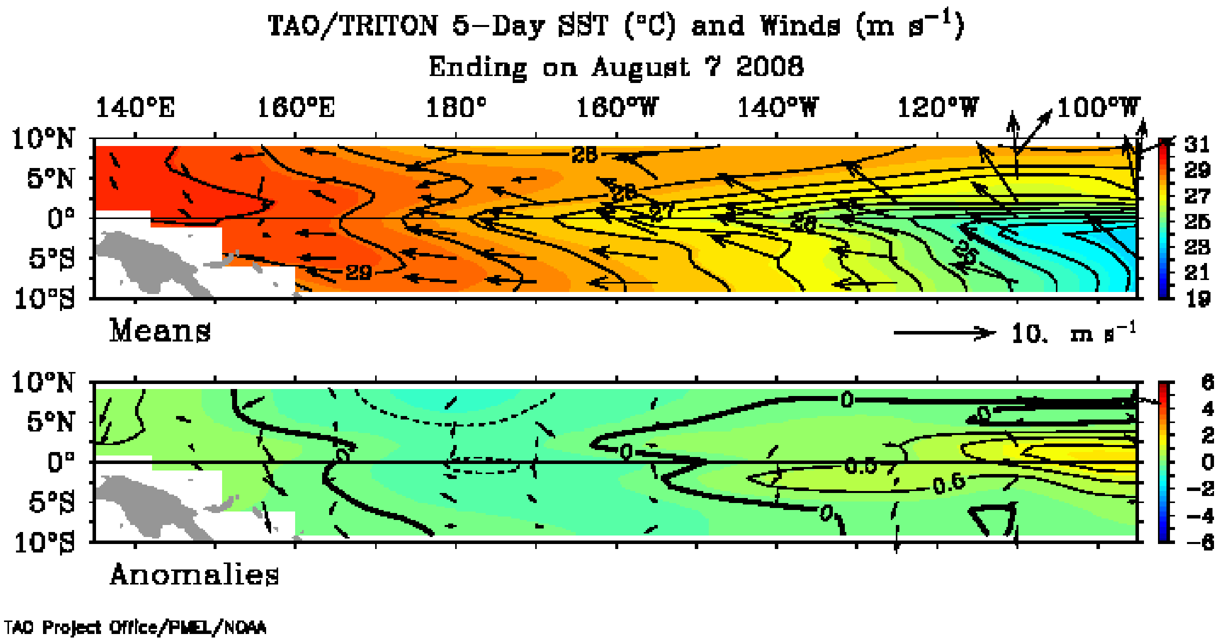


Figure 1; Sea surface temperature (contours) and surface wind velocity (arrows) from the TAO / TRITON mooring array. The upper panel shows the measured values and the lower panel shows the difference from climatological values. TAO / TRITON mooring locations are at the base of the wind vectors.

TAO / TRITON data return remains good, with an overall value for real-time primary data availability of 87% for the time period 1 October 2007 to 12 August 2008. (Data return statistics for the period 1 October 2007 to 30 September 2008 will be available at the time of the Panel meeting.) Damage to moorings and sensors due to fishing activity continues to be of concern. This damage accounts for a significant amount of data loss, especially in the far eastern and far western portions of the Pacific basin.

The NDBC has been responsible for TAO field operations since 1 January 2007, while instrument preparation remains at PMEL. NDBC is developing a "refreshed" ATLAS system comprised of more "off-the-shelf" components. Prototype refreshed systems have deployed alongside PMEL ATLAS moorings at two sites in the TAO array, with additional deployments planned for later in 2008 and 2009. Since October 2007 (the beginning of the US FY 2008) there have been seven TAO cruises (six on NOAA Ship Ka'imimoana and one on NOAA Ship Ron Brown) with one additional cruise (Ka'imimoana) scheduled for September 2008. TAO budget reductions resulted in five of 55 moorings being extended beyond their nominal 12-month design lifetime to 18-month deployments. An RV Mirai cruise in January 2008 serviced six TRITON moorings and a second RV Mirai cruise in July 2008 serviced nine TRITON moorings. The number of ship days at sea for FY 2008 will be about 320 (260 by NOAA and 60 by JAMSTEC), assuming the schedule is kept for the remainder of the year.

PIRATA

The Prediction and Research Moored Array in the Tropical Atlantic (PIRATA) moored array has completed its pilot phase (reflected in a redefinition of the acronym, Bourles *et al.*, 2008) and continued in a 17 surface mooring and one subsurface ADCP mooring configuration in 2008. Mooring preparation, data processing and evaluation are provided by the United States. Ship time for mooring maintenance is provided by Brazil, France and the US. Cruises are staffed by US, French and Brazilian technicians.

PIRATA real-time data return for the time period 1 October 2007 to 12 August 2008 was 79%. PIRATA data return has typically been lower than that for TAO, primarily due to a greater relative amount of vandalism (concentrated in the Gulf of Guinea) and a smaller array size. The occurrence of vandalism can be episodic (perhaps in response to the abundance of fish and number of fishermen) and the amount of vandalism appears to have been lower than normal for PIRATA in the past two years. In 2008 data return was adversely affected by the cancellation of an April 2008 cruise aboard NOAA Ship Ron Brown (see below) which was to service four ATLAS moorings in the PIRATA North East Extension, extending the deployment of these moorings well beyond their 12-month design lifetime.

One FY 2008 PIRATA cruise has been completed (36 days in March-May 2008 on Brazil's RV Antares) and another is scheduled for late August / September 2008 (about 25 days on France's RV Antea). A cruise aboard NOAA Ship Ron Brown in April 2008 was cancelled due to problems with the ship. NOAA is chartering 29 days on RV Antea in October 2008 to replace the lost Ron Brown days.

A new collaboration between PMEL and the US Navy's African Partnership Station was formed to provide for unscheduled maintenance of PIRATA moorings in the tropical Atlantic Ocean. An ATLAS mooring at 0º, 10º W in the Gulf of Guinea was repaired in January 2008 by crew members of the Navy's High Speed Vessel (HSV) 2 SWIFT. The Navy enthusiastically supported the collaboration and featured it in an article on their website.

PIRATA data support research efforts that have defined the role of oceanic and atmospheric processes in controlling sea surface temperature variations on interannual and decadal time scales in the tropical Atlantic. Specific results indicate that the record high SSTs in the north tropical Atlantic during the record high 2005 hurricane season were the product of a weakened northeast trade wind system that reduced evaporative cooling, modified ocean circulation patterns, and decreased cloud cover (Foltz and McPhaden, 2006). Likewise, PIRATA data were used to challenge the hypothesis that heavy dust loading of the atmosphere in 2006 was the primary cause of reduced SSTs during the quieter (compared to 2005) Atlantic hurricane season (Foltz and McPhaden, 2008).

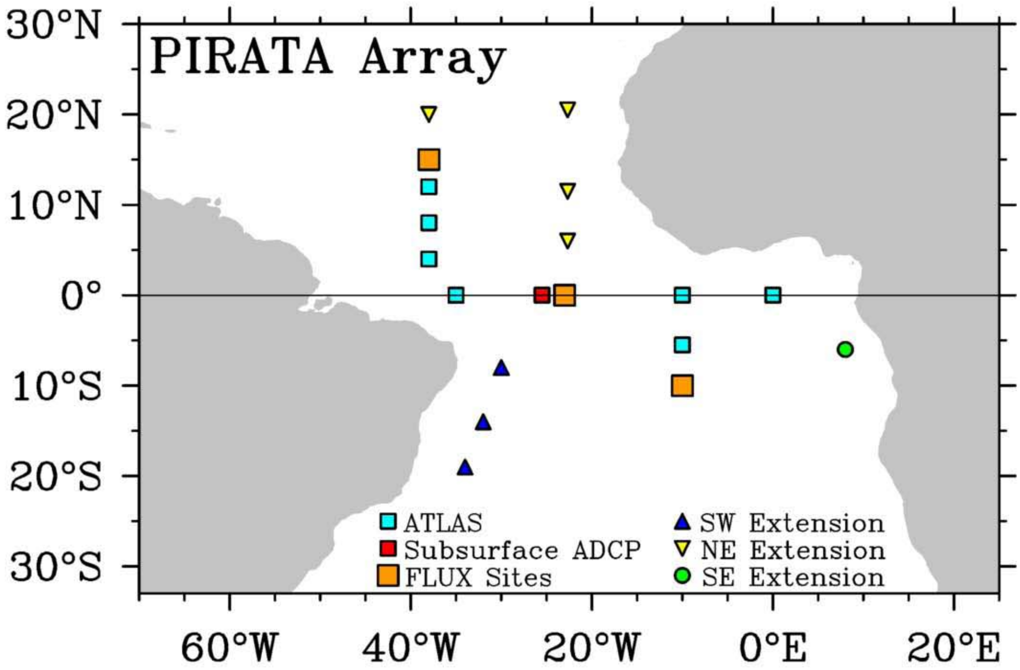


Figure 2: Mooring locations within PIRATA.

RAMA

The CLIVAR / GOOS Indian Ocean Panel (IOP) developed a plan in 2004 for a new observational network designed to address outstanding scientific questions related to Indian Ocean variability and the monsoons. The moored buoy component of the network (given the name Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction, or RAMA, in 2007) consists of a basin scale network of 46 deep ocean moorings that, like TAO / TRITON and PIRATA, provide essential data to complement other existing satellite and in situ observations in the region.

Nations providing support for RAMA include the United States, Japan, India, Indonesia, China, and France, with South Africa to soon join the list. The number of occupied RAMA sites will have increased by five in FY 2008. Two new moorings were deployed from the RV Sagar Kanya in November 2007 at 12º N 90º E and 15º N 90º E. Also in November 2007, China's First Institute of Oceanography (FIO) and Indonesia's Agency for Marine and Fisheries Research (AMFR) and Ministry of Marine Affairs and Fisheries (DKP) deployed a subsurface mooring near Java at 8.5º S 106.75º E. Two additional ATLAS moorings will be deployed at 4º S, 80.5º E and 8º S, 80.5º E in August 2008 from India's new RV Sagar Nidhi. By the end of FY 2008 moorings will have been deployed at 20 of the 46 sites (implementation 44% complete). The array includes 12 ATLAS (US), three Deep Ocean (India), two TRITON (Japan), and three sub-surface ADCP (one each, US, Japan and China).

At least 118 sea days will have been provided in support of RAMA in FY 2008; 67 days by India, 32 days by Japan, 11 days by Indonesia and eight days by France. (An unknown number of days were provided for the deployment of China's ADCP mooring from Indonesia's RV Baruna Jaya. The number is assumed to be relatively small considering the proximity of the mooring to Java.) Difficulty in obtaining timely and sufficient sea days has lead to many RAMA moorings being deployed longer than their intended 12 months. For example, three moorings deployed in September 2006 along 80.5º E were not revisited until August 2008 (23 months later) and four moorings deployed in September / October 2007 will not be revisited before April 2009 (18-19 months). A realistic estimate of sea days necessary to fully maintain the completed array is 200 days per year. Formal bilateral agreements are either under development or approved between agencies in the various partner countries to help complete and sustain the array.

South Africa's Agulhas and Somali Current Large Marine Ecosystems (ASCLME) Project will provide ship time in November 2008 to deploy two new ATLAS moorings at 8º S, 55º E and 12º S, 55º E from the Norwegian RV Dr Fridtjof Nansen. In addition, China's FIO has plans to deploy a surface mooring of their own design in the south-eastern portion of RAMA. When these moorings are deployed the implementation of RAMA will be 50% complete.

In the February 2008, JAMSTEC replaced the two TRITON sites with newly developed m-TRITON surface buoys. Based on the TRITON technology, the m-TRITON employs a smaller buoy providing a wider range of deployment opportunities. Japan and Indonesia held a joint workshop in July 2008 to discuss technical and logistical areas of mutual interest.

To address the problem of theft of instrumentation, PMEL has replaced standard hardware on surface moorings with hardware that requires special tools since September 2007. Two of the moorings deployed in August 2008 contained no meteorological sensors and the buoys are modified to discourage vandals from boarding or attaching lines to the buoy. Sea surface and sub-surface measurements will continue to be telemetered from these moorings from a transmitter embedded in the buoy. If this modification results in a decrease in mooring loss, surface meteorological sensors with vandal resistant packaging may be reintroduced to the sensor suite.

Even though in the initial stages of development, RAMA is providing valuable data for describing and understanding variability in the Indian Ocean, with recent publications on intraseasonal variability and Indian Ocean Dipole development. RAMA also captured the development of cyclone Nargis in April - May 2008, the worst nature disaster to affect the region since the Asian tsunami in December 2004. Data collected during Nargis illustrate the powerful ocean-atmosphere interactions that occur in the Bay of Bengal during the life cycle of severe life threatening storms.

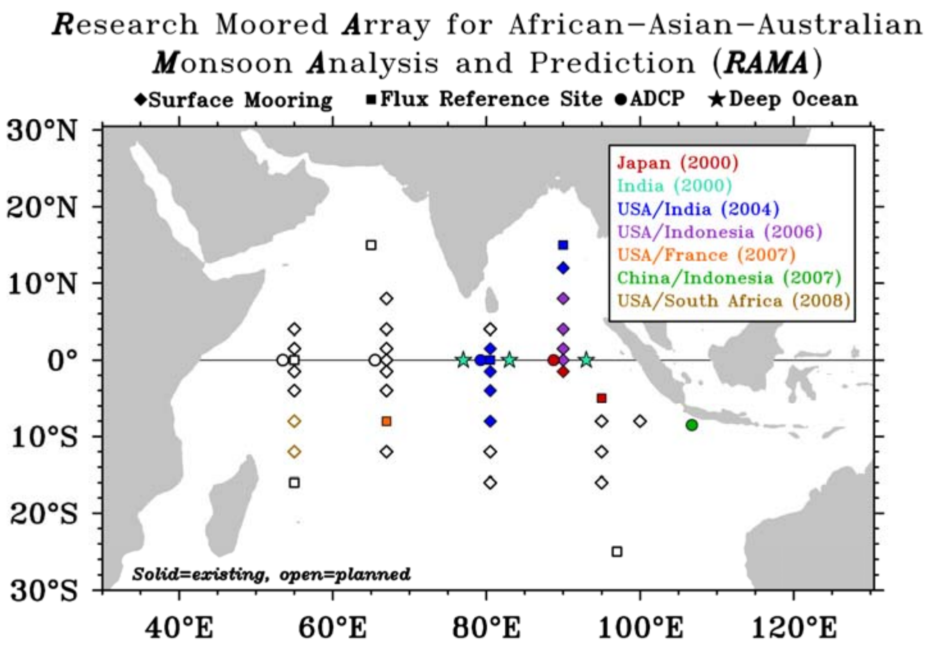


Figure 3: Mooring locations within RAMA.

The primary data telemetered in real-time from surface moorings in the TAO / TRITON, PIRATA and RAMA Arrays are daily mean surface measurements (wind speed and direction, air temperature, relative humidity and sea surface temperature and salinity) and sub-surface temperatures. ATLAS and TRITON moorings provide optional enhanced measurements, which include precipitation, short and long wave radiation, barometric pressure, salinity, and ocean currents. These enhancements provide heat, moisture and momentum flux measurements at four TAO, one TRITON, three PIRATA and two RAMA moorings. High temporal resolution (10-min. or hourly) measurements are available in delayed-mode.

TAO / TRITON, PIRATA and RAMA all support the Ocean Sustained Interdisciplinary Timeseries Environment observation System (OceanSITES), a worldwide network of deep water reference stations providing high temporal resolution data in real-time for ocean research and environmental forecasting. Embedded within these arrays are the specially instrumented reference sites for air-sea heat, moisture and momentum fluxes mentioned above. PMEL is developing a web page specifically designed for the distribution of OceanSITES data and products from the Tropical Moored Buoy Arrays. Several moorings also support OceanSITES observatories for carbon and biological measurements in collaboration with PMEL's CO_2 Program, the LOCEAN CO_2 Program at the University of Paris VI, and MBARI's Biological Oceanography Group.

More information on TAO / TRITON, PIRATA, and RAMA along with data display and dissemination are available on the web at www.pmel.noaa.gov/tao.

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REPORT BY E-SURFMAR
EUCOS-SURFACE MARINE PROGRAMME
2008

1. INTRODUCTION

The EUMETNET Composite Observing System (EUCOS) surface marine (E-SURFMAR) Programme is an optional programme involving 17 out of the 24 EUMETNET members: (Belgium, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, The Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom), 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 to manage these activities. The DBM is supported and advised by the E-SURFMAR Data Buoy Technical Advisory Group (DBTAG) which has superseded the European Group on Ocean Stations (EGOS) as an action group of the DBCP. The fifth annual DB-TAG meeting was held in Reykjavik, Iceland, 20-21 May 2008.

2. OPERATIONAL PROGRAMME

2.1 Drifting buoys

Seventy-eight drifting buoys were deployed between September 2007 and August 2008 including **eight** upgrades of SVP drifters. **Forty-three** out of the SVP-B were fitted with Iridium transmitters.

Deployments in 2007 / 08 were carried out by research vessels, voluntary observing ships, and ships of opportunity plying the Atlantic Ocean from ports including Halifax (Canada), Reykjavik (Iceland), Foynes (Ireland), Le Havre (France), Fos (France), Brest (France), London (UK), Fairlie (UK), Charleston (USA), Boston (USA), Trondheim and Aalesund (Norway). Drifting buoys are regularly deployed from OWS Mike (66° N – 2° E) as well.

Although the E-SURFMAR area of interest is mainly up to 70° N (i.e., to the ice limits), the EUCOS area actually extends to 90° N. **Three** ICEB buoys and **four** SVP-B (two with Iridium transmitters) were deployed by September 2007 in the Arctic for IPY (International Polar Year) in addition to the seventy-eight drifting buoys.

The deployments balanced the loss of buoys which occurred during the year. An average of about 90 drifting buoys were in operation in the EUCOS area of interest. The minimum number of operational drifting buoys at the end of each month in 2007-2008 was 84 (in February 2008) and the maximum was 100 (in July 2008).

The mean lifetime (for Air Pressure) of the SVP-B drifters was approximately 14 months (425 days). The average age of the network was 287 days by the end of August 2007 and 359 days by the end of August 2008. Sixty-five buoys failed to report air pressure measurements.

Most of drifting buoys used the Argos system to report their data during the first part of the session. The evaluation of the Iridium communication system began as a contribution to the DBCP drifter Iridium Pilot Project. The Iridium drifters have been increasingly deployed during the year and by the end of the session more than 1/3 of the buoys operating were using Iridium, which will be used more in the future. This improves the data timeliness and also has a lower transmission cost.

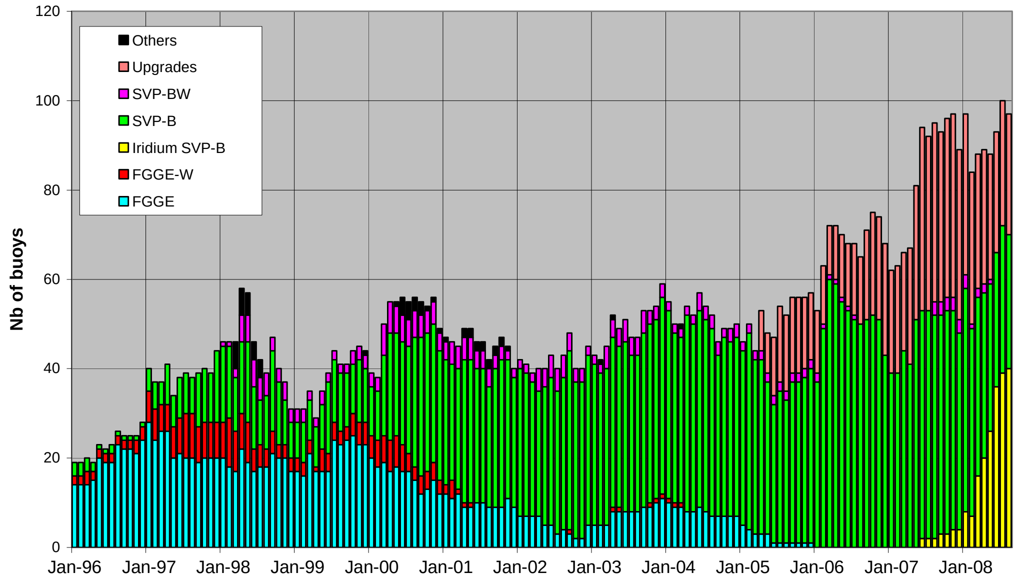


Figure 1: The number of operational EGOS/E-SURFMAR drifting buoys by the end of each month from 1996 to 2008

The availability, timeliness and quality of drifting buoy data continue to be carefully monitored.

The availability of data depends on the number of buoys operating in the EUCOS area. About 800 messages per day were received within 50 minutes in September 2007. E-SURFMAR can note an improvement from beginning of 2008 with more than 1300 messages per day in August mainly due to the use of Iridium satellite system. More than 2000 hourly observations per day had been reported on the GTS during the inter-sessional period.

The AP differences from the French model outputs showed that the target of 1% of Gross Errors was easily being achieved. The RMS of AP differences still had a seasonal variation, being higher in winter (0.8 hPa) than in summer (0.5 hPa). This could be due to less accurate measurement in rough seas and also to more low pressure systems crossing the North Atlantic in winter.

Real-time observations from drifting buoys are subject to routine quality monitoring. Besides monthly statistics provided by various meteorological centres for individual buoys, tools are used by Météo-France to identify buoys reporting dubious data as quickly as possible. Among these tools is a blacklist computed over the previous 14 days which is available on the web at: http://www.meteo.shom.fr/qctools/eblackap.htm.

2.2 Moored buoys

In 2004 the E-SURFMAR design study recommended that four moored buoys were needed to meet the EUCOS requirements, i.e., providing a suitable network to improve the quality of regional NWP over Europe, and for the validation and calibration of satellite wind and wave measurements. The four E-SURFMAR moored buoys are operated by UK, Ireland, France and Spain. (i.e., three K-pattern buoys and one SeaWatch buoy, respectively).

In accordance with the MOU between EGOS and E-SURFMAR the monitoring of the previous EGOS moored buoy network has been continued. The availability, timeliness and quality of moored buoys data are carefully monitored. By the end of August 2008, 12 K-pattern buoys and 17 Ocean or buoys were operating.

The INM (Spain) is reporting data from the Cabo Silleiro buoy (as well as others operated by Puertos del Estado) to the GTS in BUFR code. The messages received in Toulouse RTH are forwarded to Exeter and Offenbach. However, these data are apparently not yet being processed or used by forecast meteorological centres. The INM is working to modify the BUFR code they use to the BUFR template proposed by the DBCP.

At present, of the four E-SURFMAR moored buoys, only Cabo Silleiro and K5 are able to provide directional wave spectra data. Lion is providing omni-directional wave spectra. A new buoy at K5, with a Triaxys spectral wave system was deployed in July. The data are presently being archived by the Met Office in NMEA format while the ability to generate BUFR messages and issue to GTS is developed.

The availability of moored buoy data depends on the number of buoys operating. An average of 150 hourly observations per day have been reported on the GTS from the initial EUCOS buoys. About 70 messages per day were reported from the 3 K-pattern E-SURFMAR buoys.

More than 95% of data were received by HH+50 minutes (to be compared to the timeliness of the EUCOS target 85%) for the K-pattern buoys.

The Air Pressure (AP) differences with the French model outputs shows the target of 0.5% of Gross Errors was achieved. The RMS of AP differences are between 0.5 to 0.8 hPa.

Real-time observations from moored buoys are subject to routine quality monitoring in the same way as drifting buoys.

3. PLANS

3.1 Drifting buoys

The E-SURFMAR design study has recommended the deployment of an average of 175 SVP-B type drifters per year. For financial reasons (buoy and transmission costs) this will take several years to achieve. However, the drifting buoy component has been fully funded by E-SURFMAR since 2006, i.e., in addition to the drifting buoy purchases, all the communication costs are funded by E-SURFMAR. Within the allocated budget more than 100 buoys (including 30 upgrades) will deployed in the
E-SURFMAR area of interest in the coming twelve months.

The transmission of drifting buoys data through Iridium will be more and more used as an alternative to Argos.

E-SURFMAR will continue to deploy buoys in the Arctic Ocean through IABP. The main challenge with the ice buoys is their ability to survive after being released from frozen ice.

3.2 Moored buoys

K5 (59.1 N – 11.5 W), Cabo Silleiro (42.1 N – 9.4 W), Lion (42.1 N – 4.7 E) and M6 (53.1 N – 15.9 W) are designated as E-SURFMAR moored buoys.

The E-SURFMAR design study has recommended that directional wave spectra should be provided by all four buoys. By fall 2008, K5 buoy should report directional wave spectra data through Iridium four times each day at the main synoptic hours. Once proven the system could be procured and installed on the M6 and Lion buoys.

4. INFORMATION ON E-SURFMAR

There is a EUCOS website (http://www.eucos.net). Under the heading “EUCOS Public” in “EUCOS networks” there is information about E-SURFMAR. This site is the official public site for E-SURFMAR. A link will be provided from this site to provide access to publicly available documents such as the reports.

In addition, there is a restricted working area web site for E-SURFMAR participants (http://esurfmar.meteo.fr). This site is based on a collaborative scheme which allows the participants to easily create and modify certain pages.

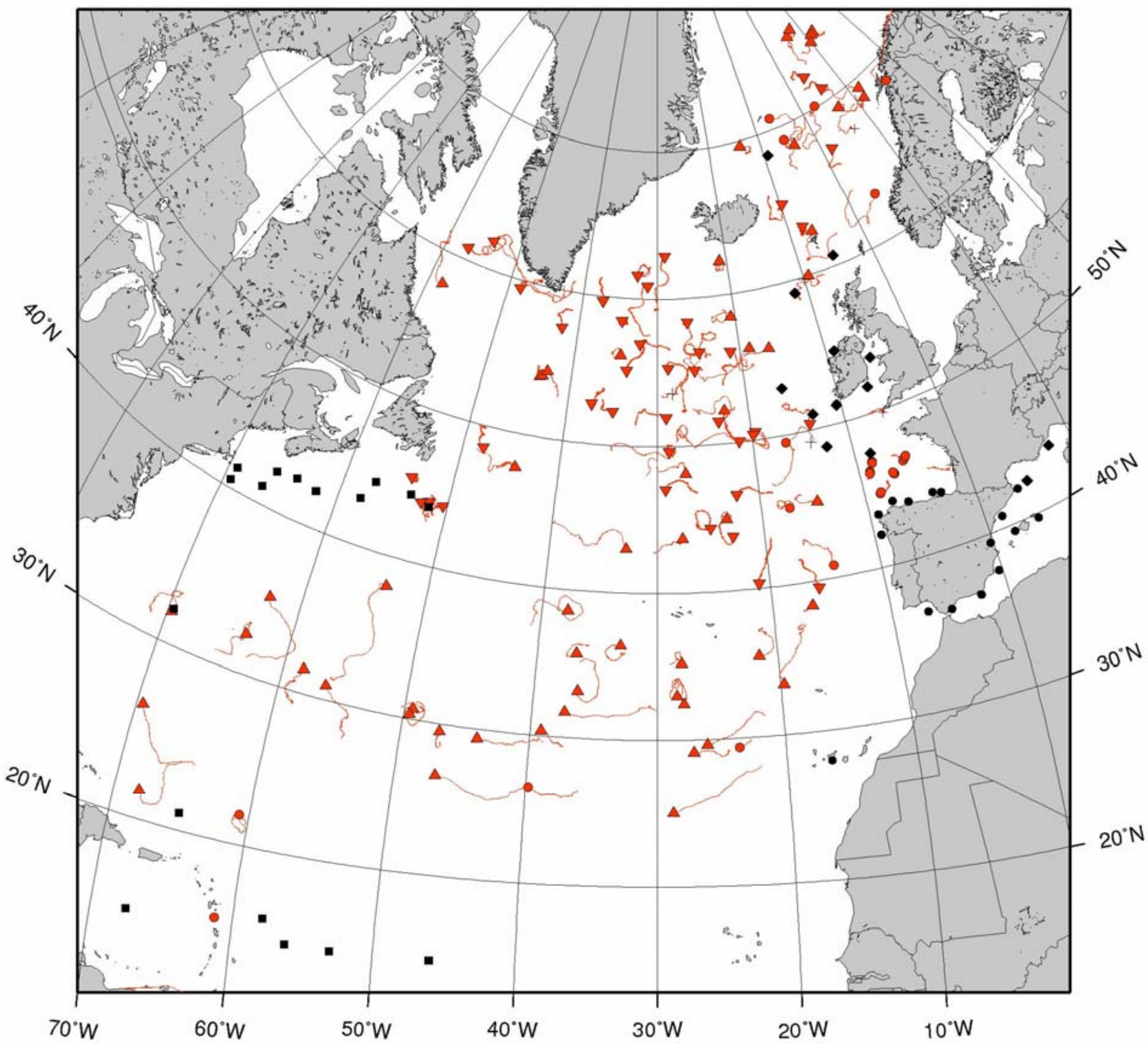


Figure 2: Operating Buoys in E-SURFMAR area Drifting buoy trajectories and moored buoy positions (August 2008)

REPORT BY THE INTERNATIONAL BUOY PROGRAMME FOR THE INDIAN OCEAN (IBPIO) 2008

1. INTRODUCTION

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.

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, etc.).

There are presently ten organisations formally participating in the IBPIO:

- Australian Bureau of Meteorology (ABOM);
- Eduardo Mondlane University (EMU) Mozambique;
- Global Drifter Center of NOAA/AOML (GDC), USA;
- Kenya Meteorological Department (KMD);
- Météo-France;
- National Institute of Oceanography (CSIR / NIO), India;
- National Institute of Ocean Technology (DoD / NIOT), India;
- Navoceano, USA;
- South African Weather Service (SAWS); and
- Tropical Moored Buoy Implementation Panel (TIP).

2. PROGRAMME MEETINGS

The eleventh Programme Committee meeting of the IBPIO will be held in Cape Town, Republic of South Africa, on 11 October 2008, prior to DBCP-XXIV. The tenth Programme Committee meeting of the IBPIO was held on 13 October 2007 in Jeju, Republic of Korea, in conjunction with DBCP-XXIII.

3. OPERATIONAL PROGRAMME

3.1 Drifting buoys

Since the beginning of the programme, 1259 drifting buoys (437 SVP and 730 SVP-B) Lagrangian drifters) have been deployed at sea.

184 drifting buoys were deployed between September 2007 and August 2008. All were SVP-style Lagrangian drifters, of which about 2/3 measured air pressure (SVP-B). Seven buoys measured wind (SVP-BW).

Participants in the IBPIO contribute to the programme in various ways: the provision of buoys (ABOM, GDC, Météo-France, Navoceano and NIO); the funding of barometer upgrades to SVP drifters provided by GDC (ABOM and Météo-France); deployment arrangements (all); co-ordination (Météo-France) and data transmission (Météo-France and SAWS).

Many of the deployments in 2007 / 08, as in previous years, were carried out by research vessels and ships of opportunity plying the Indian Ocean from ports in Australia, India, South Africa, La Reunion (France) and Kenya. Some ship voyages to remote islands were also used for deployments in the southern latitudes: Heard Island from Australia; Amsterdam, Kerguelen and Crozet Islands from La Reunion; and Marion Island from South Africa.

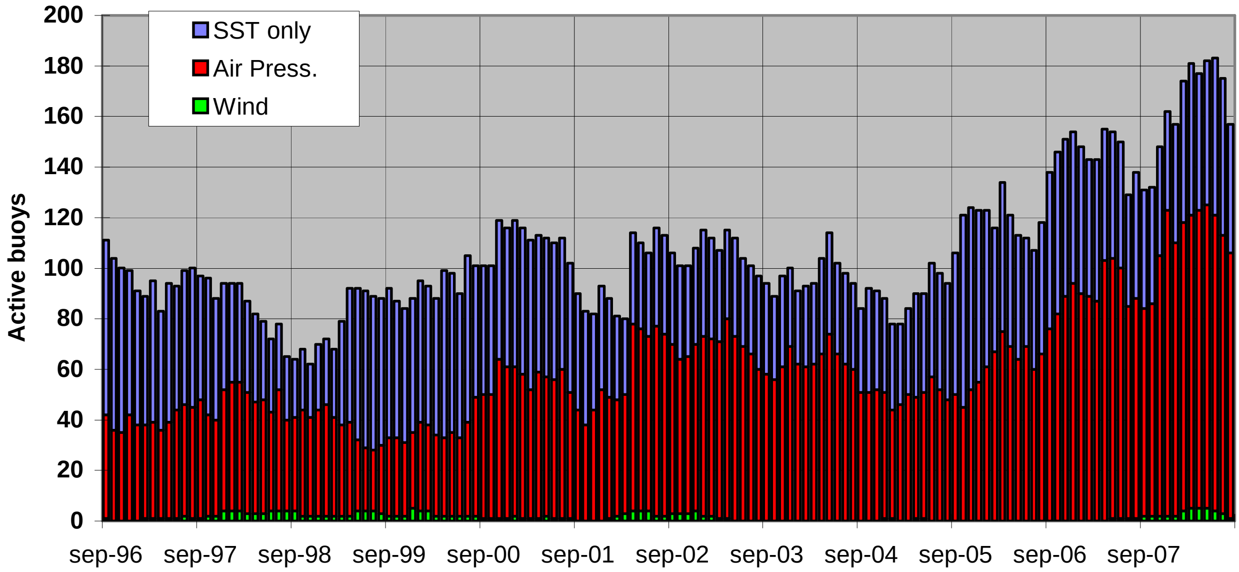


Figure 1: The number of operational IBPIO drifting buoys by parameters measured

The number of operational buoys providing AP measurements remained above 100 from November 2007, and reached a maximum of 120 in May 2008 (about 2/3 of the total).

The number of buoys measuring SST only - in addition to their position – was about 1/3 of the total (minimum 39 by December 2007, maximum 62 by July 2008). There were only a few drifting buoys reporting wind parameters during the year.

During the period from September 2007 to August 2008, 57 buoys owned by SAWS or GDC migrated from the South Atlantic Ocean and / or Southern seas to the IBPIO area of interest. In contrast, the number of buoys that escaped to the south of Australia was 39 during the same period. Some of these escaping buoys were deployed near the SE boundary of IBPIO. The Indian Ocean benefits from a natural convergence that directs the buoys coming from the South Atlantic to the middle of the South Indian Ocean.

Owner	SST only	Air Pressure	Wind
Australian Bureau of Meteorology	0	14	1

Global Drifter Center	50	79*	0
SAWS	1	0	0
Météo-France	0	0	0
NIO	0	10	0
INCOIS	0	2	0
Total	**51**	**105**	**1**

Table 1: Operational drifting buoys (i.e. reporting onto the GTS) at the end of August 2008
**** including drifters upgraded***

Most drifting buoys use the Argos system to report their data (with DBCP-M2 format); however, a small number of buoys fitted with Iridium transmitters were deployed in support of the DBCP Iridium Pilot Project. Australia, France and India collectively deployed sixteen Iridium buoys. Iridium offers the advantages of better timeliness and lower cost per message.

The availability of data depends on the number of buoys operating in the area. The number of reports with AP received within 50 minutes showed a slight improvement during this intersessional period, but still remains at about 20% per day. More than 2000 (AP) hourly observations per day have been reported on the GTS since November 2007, reaching a maximum of more than 2700 by March / April / May 2008.

The timeliness at HH+100 minutes is about 55%.

Real-time observations from drifting buoys are subject to routine quality monitoring. Besides monthly statistics provided by various meteorological centres for individual buoys, tools are used by Météo-France to identify buoys reporting dubious data as quickly as possible. Among these tools is a blacklist computed over the previous 14 days which is available on the web at: http://www.meteo.shom.fr/qctools/blackap.htm .

3.2 Moored buoys

The Department of Ocean Development (DoD, India), now known as Ministry of Earth Sciences, through the National Institute of Ocean Technology (NIOT), has established the National Data Buoy Programme (NDBP) to collect real-time meteorological and oceanographic data from moored data buoys in Indian waters.

With the objectives of measuring different met-ocean parameters such as Wind Speed and Direction, Atmospheric Pressure, Air Temperature, Humidity, Conductivity, Sea Surface Temperature, Current Speed and Direction and Wave Parameters, and to create a good data base for Weather Prediction / Early Cyclone Warning, Ocean State Model Calibration, Climate Research, Satellite Data Validation, Port Development / Navigational Use, Engineering / offshore project and Safety of Life at Sea, a variety of categorized data buoys such as Met buoys, Ocean buoys, Environmental buoys and Port buoys have been developed and deployed.

A network of 43 Moored buoys has been established. In August 2008, 16 buoys were operational (WMO Id's: 23092, 23100, 23102, 23170-23172, 23491 and 23493-23500) and the real-time data were transmitted by IMMARSAT / INSAT. Since mid-2000, the surface meteorological data have been distributed on the GTS in FM 18 BUOY code by IMD (Bulletin header SSVX01 DEMS).

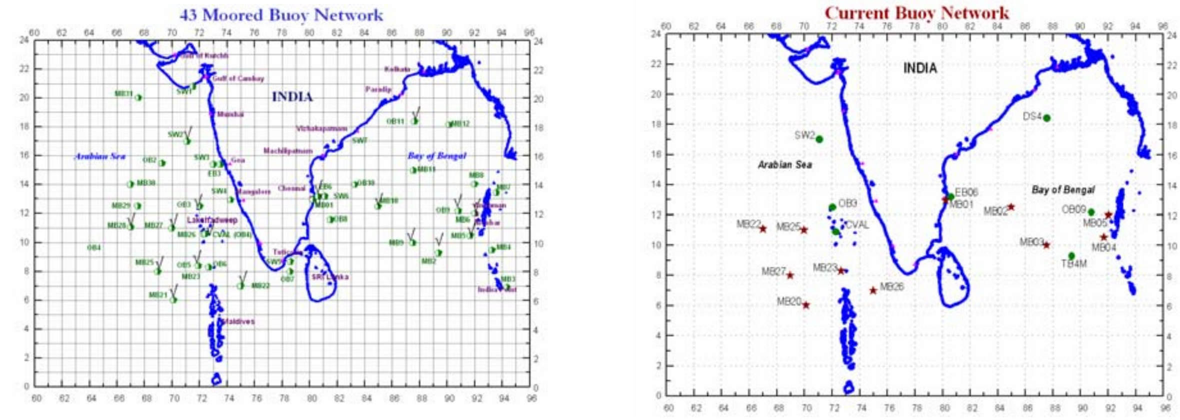


Figure 2: NIOT Moored buoy network

The moored buoy network requires regular maintenance due to vandalism and severed moorings.

A network of ten deep ocean tsunami detection systems has been established. Each system contains a surface buoy and a Bottom Pressure Recorder (BPR). The real-time data received at NIOT are transmitted to INCOIS for further dissemination.

The Japan Marine Science and Technology Center (JAMSTEC) maintains a sub-surface ADCP mooring near 0° 90°E. This mooring, which reports data in delay-mode, was first deployed in 2000. Two TRITON buoys are also maintained by JAMSTEC. These buoys were first deployed in the eastern tropical Indian Ocean in November 2001 at 5° S 95° E (WMO Id. 53056) and 1.5° S 90° E (WMO Id. 53057). The moorings are serviced on an annual basis. In the February 2008, JAMSTEC replaced the two sites with newly developed m-TRITON surface buoys which are based the TRITON technology and report on the same WMO Id. Neither buoy is transmitting data at the present time. JAMSTEC plans to restart these measurements in February 2009.

Building upon the tropical mooring networks of India and Japan, the CLIVAR / GOOS Indian Ocean Panel (IOP) developed a plan in 2004 for the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA), a new observational network designed to address outstanding scientific questions related to Indian Ocean variability and the monsoons. The plan consists of a basin scale network of 46 deep ocean moorings that, like TAO / TRITON and PIRATA, provide essential data to complement other existing satellite and in situ observations in the region. Nations that have provided mooring equipment, ship time, personnel, and / or logistic support so far include the United States, Japan, India, Indonesia, China and France.

The US began a sustained Indian Ocean mooring program in October / November 2004 with ship time provided by India's DoD (now MoES) on the Ocean Research Vessel (ORV) Sagar Kanya. Three PMEL ATLAS moorings were deployed along 80.5° E (1.5° N, 0°, 1.5° S) and one at 0° 90° E). In addition, a sub-surface ADCP mooring was deployed near 0° 80.5° E. PMEL expanded the Indian Ocean array in late 2006 – early 2007 by deploying four additional ATLAS moorings (three along 90º E between 1.5º N and 8º N, and one at 8º S, 67º E) from research vessels provided by India, Indonesia and France.

In the past year, the number of sites at which moorings have been deployed increased by five.

Two moorings were deployed from the Sagar Kanya in November 2007 along 90º E at 12º N and 15º N. Also in November 2007, China's First Institute of Oceanography (FIO) and Indonesia's Agency for Marine and Fisheries Research (AMFR) and Ministry of Marine Affairs and Fisheries (DKP) deployed a sub-surface mooring near Java at 8.5º S, 106.75º E. The array expanded by two sites in August 2008 when PMEL deployed two ATLAS moorings from India's new RV Sagar Nidhi. These additions bring the total number of moorings in the array to 20 (14 surface, six sub-surface) or 44% of the planned 46 mooring array.

The combination of heavy vandalism and moorings being deployed for long periods between maintenance cruises resulted in data return rates significantly lower than those for the tropical moored buoy arrays in the Pacific and Atlantic Oceans. Difficulty in obtaining timely and sufficient sea days has lead to many RAMA moorings being deployed longer than their intended 12 months. For example, three moorings deployed in September 2006 along 80.5º E were not revisited until August 2008 (23 months later) and four moorings deployed in September / October 2007 will not be revisited before April 2009 (18-19 months). As of August 2008, nine of 14 surface moorings were reporting on the GTS (WMO ID's: 14040, 23001, 23002, 23003, 23004, 23007, 23008, 23010 and 53005). The loss of data emphasizes the need for sustained and regular ship support for the mooring program to succeed and for measures to combat vandalism.

At least 118 sea days will be provided in support of RAMA from October 2007 through September 2008; 67 days by India, 32 days by Japan, 11 days by Indonesia and eight days by France. (An unknown number of days were provided for the deployment of China's ADCP mooring from Indonesia's RV Baruna Jaya. The number is assumed to be relatively small considering the proximity of the mooring to Java.) A realistic estimate of sea days necessary to fully maintain the completed array is 200 days per year. Formal bilateral agreements are either under development or approved between agencies in the various partner countries to help complete and sustain the array.

Even though in the initial stages of development, RAMA is providing valuable data for describing and understanding variability in the Indian Ocean, with recent publications on intraseasonal variability and Indian Ocean Dipole development. RAMA also captured the development of Tropical Cyclone Nargis in April - May 2008, the worst natural disaster to affect the region since the Asian tsunami in December 2004. Data collected during TC Nargis illustrate the powerful ocean-atmosphere interactions that occur in the Bay of Bengal during the life cycle of severe life threatening storms.

4. PLANS

IBPIO participants are regularly encouraged to increase their contributions of buoys, or to fund barometers to equip SVP drifters provided by GDC. Météo-France and ABOM have funded barometer upgrades in the Indian Ocean since 1996 and 2000, respectively. Some Iridium drifters will be deployed for evaluation during the next intersessional period.

4.1 Tropical regions

Efforts are aimed mainly at filling data gaps in the tropical regions, primarily during the Tropical Cyclone seasons. In the southern tropical area, the buoys are provided by NOAA / GDC and routinely include about 10 barometer upgrades funded by Météo-France. The ABOM plans to deploy nine 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 (at least 15 SVP-B and 4 SVP-BW).

The GDC will provide ten SVP with barometer upgraded by NOAA / SIO to the WMO Sub-Region Office for Eastern and Southern Africa in Kenya. The GDC plans to supply 55 SVP drifters (i.e., without barometer) for deployment in the Indian Ocean if opportunities exist.

South Africa will join the nations supporting RAMA in November 2008 by providing ship time to deploy ATLAS moorings at two new sites. Cruises planned for the coming year include:

Date	**Ship**	**Sites**
October 2008	Sagar Kanya (Indonesia)	12º N, 15º N - 90º E
November 2008	Fridtjof Nansen (South Africa/Norway)	12º S, 8º S - 55º E (new sites)
April 2009	Baruna Jaya (Indonesia)	0º to 8º N - 90º E (4 sites)

In addition to the above, China's FIO has indicated interest in deploying a surface mooring in the south-eastern portion of RAMA.

To address the problem of theft of instrumentation, PMEL has replaced standard hardware on surface moorings with hardware that requires special tools since September 2007. Two of the moorings deployed in August 2008 contained no meteorological sensors and the buoys are modified to discourage vandals from boarding or attaching lines to the buoy. Sea surface and sub-surface measurements will continue to be telemetered from these moorings from a transmitter embedded in the buoy. If this modification results in a decrease in mooring loss, surface meteorological sensors with vandal resistant packaging may be reintroduced to the sensor suite.

4.2 Southern seas

In the Southern part of the Indian Ocean, the deployment of SVP-B drifters provided by GDC and upgraded by Météo-France (15 to 20 units a year) should continue. The ABOM plans to deploy 11 SVP-B drifters in this area over the next 12 months including six 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 up to 14 SVP-B drifters (upgraded by SIO) for deployment in the Southern Indian Ocean. The ABOM will also deploy two SVP-B buoys in or near the Indian Ocean Gyre.

The SAWS, through the PMO in Cape Town, continues to coordinate the deployment of drifters on behalf of GDC, ABOM and Météo-France from voyages to Marion Island (four voyages every year, March, April, August and November). The ABOM plans to provide two SVP-B buoys for deployment from the scheduled voyages in 2009. The PMO in Durban also provides logistic support for deployments in the Indian Ocean from Ships of Opportunity.

As in previous years, the GDC remains the biggest contributor to the IBPIO. A part of the drifters are standard SVP that only measure SST in addition to the surface current deduced from their movement.

5. INFORMATION ON THE IBPIO

IBPIO information is available on the World Wide Web at *http://www.meteo.shom.fr/ibpio/*. The main pages give a description of the programme, its objectives and management, listings of participants and links to related subjects such as DBCP data quality control information. Some pages are updated monthly with buoy trajectories and deployment log. Buoy status tables are updated less frequently.

A promotional leaflet on the IBPIO can be obtained from the Chairman or the Programme Co-ordinator.

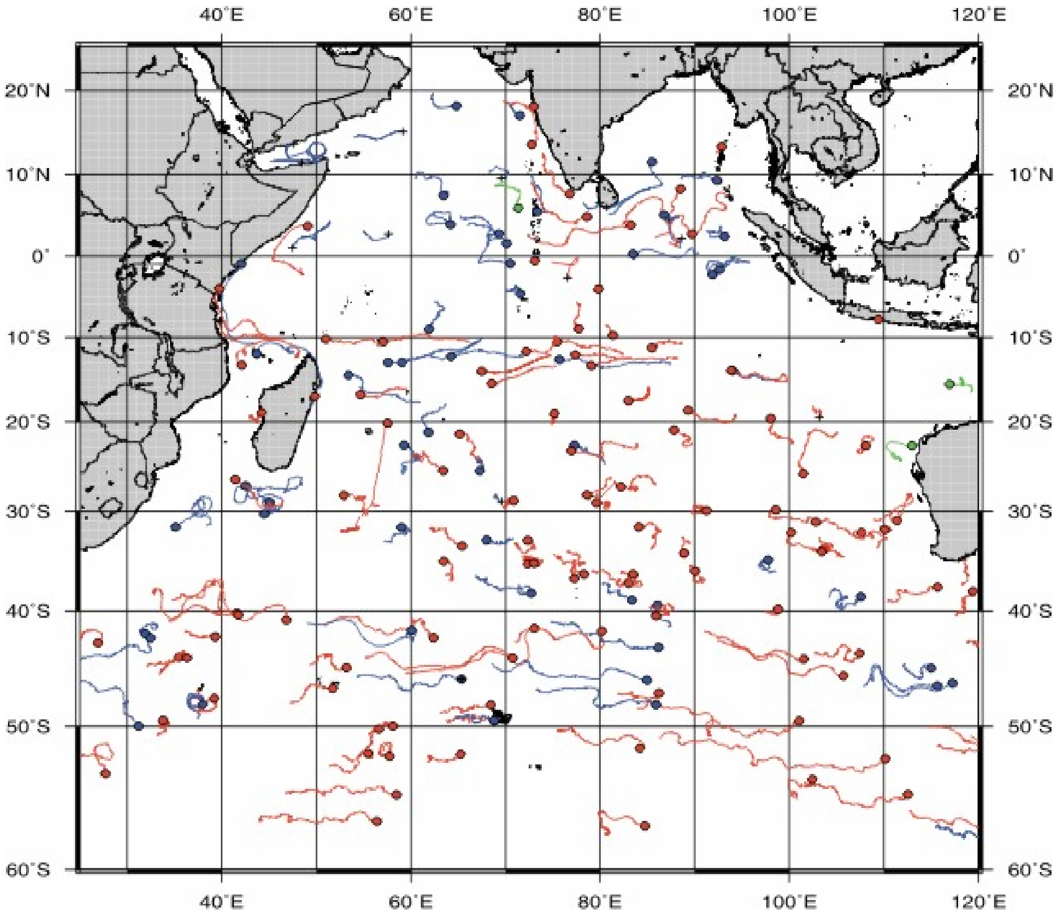


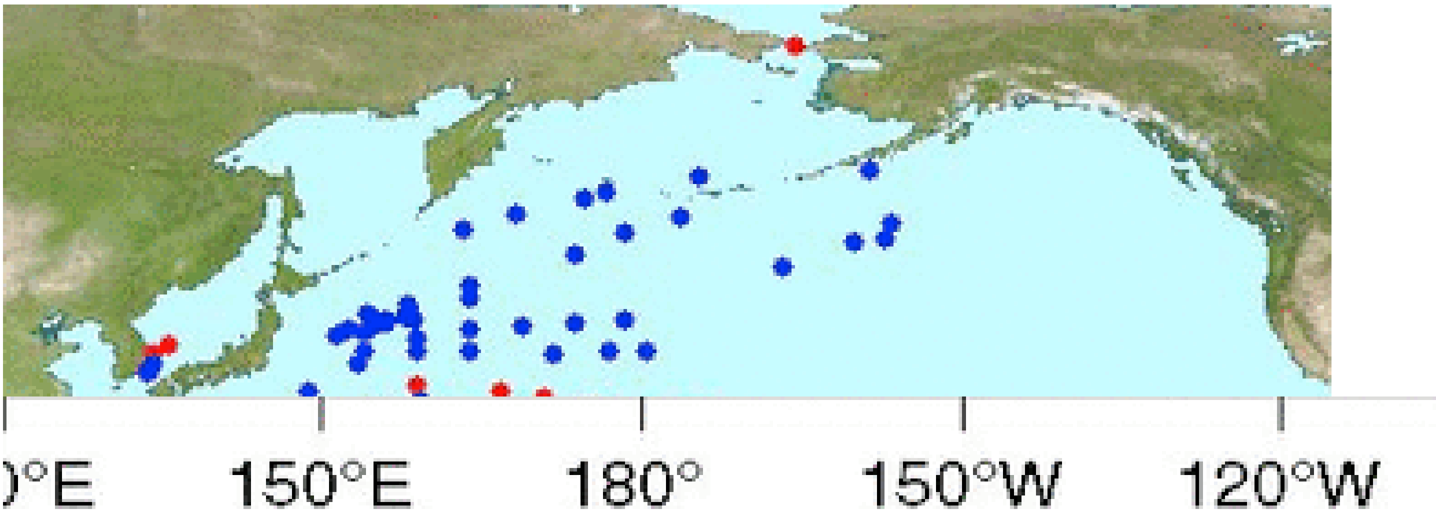
Figure 3: Buoys drifting in the Indian Ocean August 2008

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

By Shaun Dolk
University of Miami / CIMAS
NOAA / AOML

North Pacific Buoy Deployment Locations

1 September 2007 to 31 August 2008



2007-2008 Results and Current Status

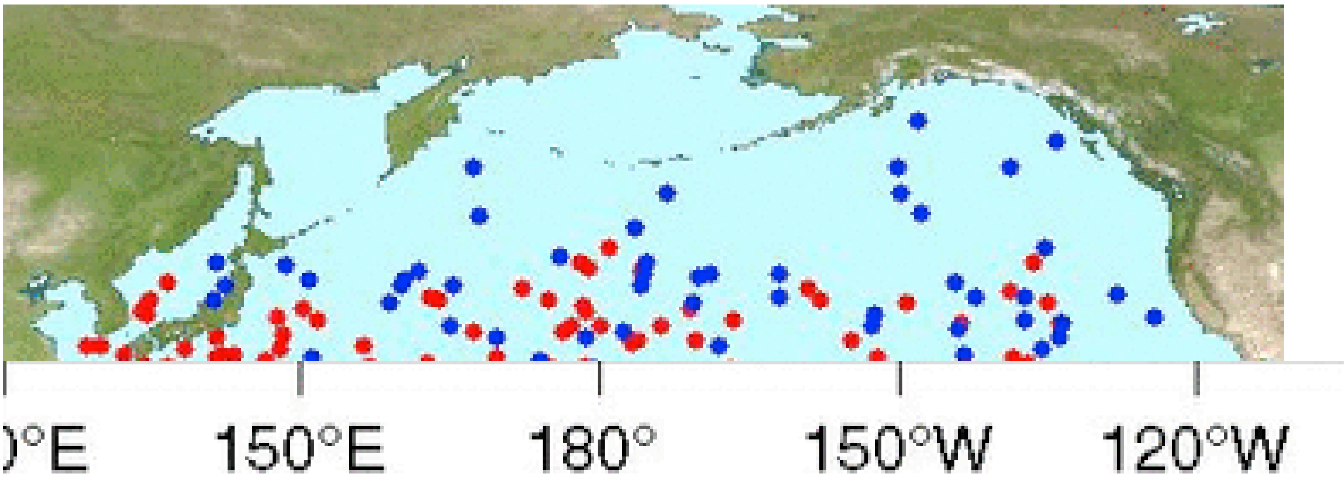
In the months between September 2007 and August 2008, there were a total of 59 buoys deployed north of 30° N and between 110° E to 110° W. Of these 59 deployments in the North Pacific, 13 of these buoys were SVP drifters (22%) and the remaining 46 buoys were SVPB drifters (78%).

While the total number of deployments in 2008 (59) is comparable to those of 2007 (63), the number of SVPB deployments has risen dramatically (from 46% to 78%).

Based on the goals set forth by the NPDBAP, four additional SVPB buoys need to be deployed in 2009 to reach the target of 50 SVPB deployments.

Current North Pacific Buoy Locations

(as of 25 August 2008)



2008-2009 North Pacific Deployment Plan

The current plan, which calls for the deployment of 50 SVPB drifters in the North Pacific Region between September 2008 and August 2009 will not only help populate the area, but also decrease the average age of active buoys.

Northwest Pacific	
120E to 145E	0 SVPB
145E to 160E	12 SVPB
161E to 175E	12 SVPB
Northwest Pacific Total:	24 SVPB
North-Central Pacific	
176E to 175W	8 SVPB
174W to 165W	8 SVPB
164W to 150W	3 SVPB
North-Central Pacific Total:	19 SVPB
Northeast Pacific	
149W to 135W	7 SVPB
134W to 125W	0 SVPB
124W to 110W	0 SVPB
Northeast Pacific Total:	07 SVPB
North Pacific SVPB Deployment Total:	50 SVPB

Methods used for deployment in the Indian Ocean will consist of:

Research Vessel (R/V) and Voluntary Observation Ship (VOS) Deployments

Buoys will continue to be deployed by Research Vessels and VOS. The GDP will work to coordinate deployment efforts with Research vessels operated by Canada, Japan, Korea, China and the United States, in addition to acquiring and maintaining lasting relationships with various VOS vessels that transit the area.

SVPB Upgrade Opportunity

The GDP provides an opportunity for Meteorological agencies to add barometers to SVP drifters deployed in the North Atlantic. More information can be found on the DBCP website under SVPB Upgrade Opportunity link: http://www.dbcp.noaa.gov/dbcp/svpb_upgrade.html.

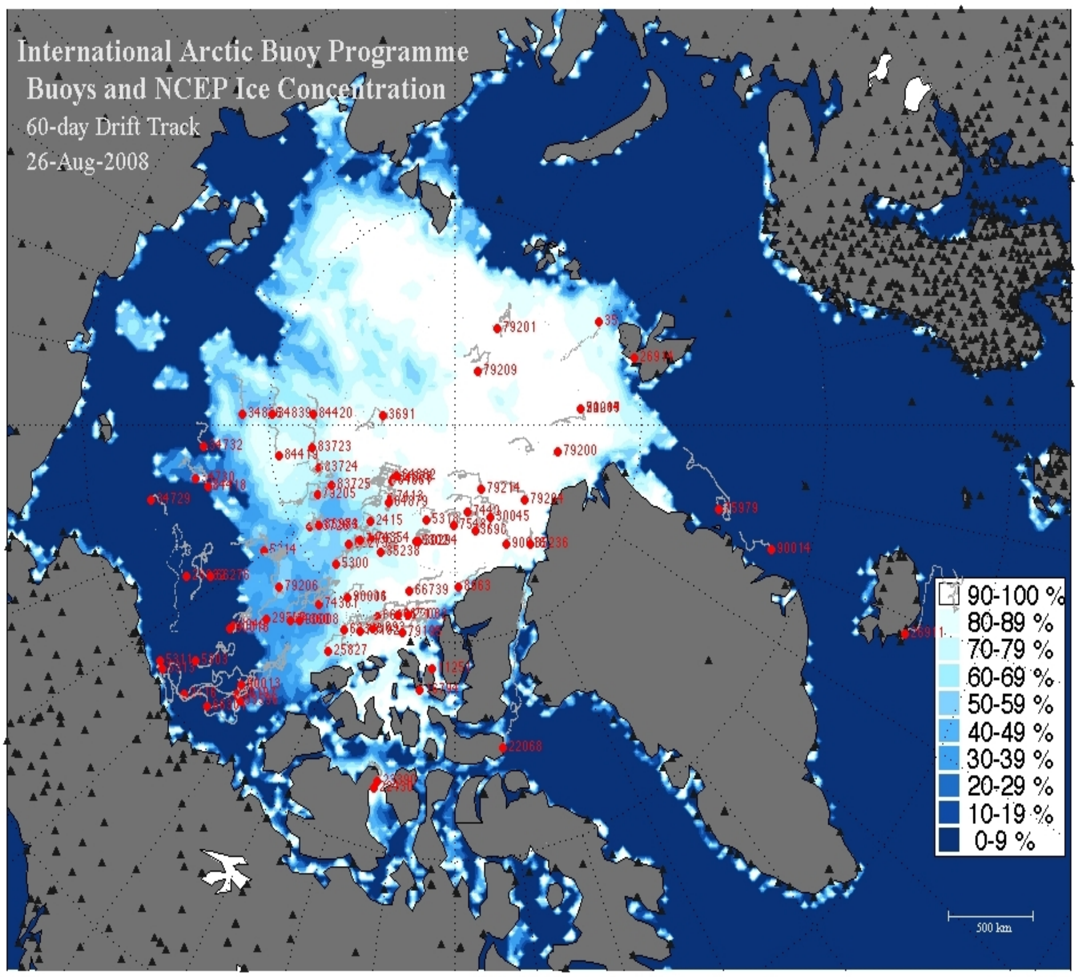
INTERNATIONAL ARCTIC BUOY PROGRAMME (IABP)
CHAIRPERSON’S AND CO-ORDINATOR’S REPORT

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.

IABP Program Status 26 August 2008

- The daily buoy status report for 26 August 2008 shows 89 buoys on the basin: This is similar to last year at this time there are more buoys on less ice than in previous years;
- The number of buoys is higher in 2007 and 2008 than in 2006 and years previous as result of and / or in support of International Polar Year activity;
- There continues to be several ice thickness and oceanographic buoys in the array; and
- Number of buoys on the Eurasian side of the pole on ice and / or in water remains low.

	2006 5 September	**2007 29 August**	**2008 26 August**
Ocean Profiling (POPS or ITP)	2	14	7
Ice Mass Balance with surface air temperature and surface air pressure	6	7	8
Ice Mass Balance with surface air pressure	1		1
Surface air temperature and surface air pressure	26	37	31
Surface air temperature	2	1	1
Surface air pressure	2	14	21
Position only	11	31	20
Total Numbers of buoys	**50**	**104**	**89**



Buoy map with 60-day buoy track and ice concentration 26 August 2008
from International Arctic Buoy Programme web page http://iabp.apl.washington.edu

IABP Program for 2009

- Number of buoys may decrease as IPY activity decreases;
- Likely to see more buoys that can survive the freeze-thaw cycle such as AXIB (**A**irdroppable e**X**pendable **I**ce **B**eacon);

AXIB just after deployment from U.S. Coast Guard cutter *Healy* August 2008

- Air deployments remain integral to program's success; and
- May see more buoys using iridium for communication in place of Argos.

Issues / Discussion

- Challenges to sustain IABP network beyond the IPY:
    - Increasing area of First-Year Ice and Open Water during summer; and
    - Getting buoys on ice / in water in the Eurasian Arctic.
- How does the IABP fit into the Sustained Arctic Observing Network (SAON)? – IABP Participants believe that the IABP supports a sustained Arctic observing network and see it as the foundation of such a network, since it is the longest, continuously standing observing program for the Arctic; and
- Buoys on ice / in water but not on GTS – Efforts to have all those putting buoys on ice / in water the arctic basin to have the data posted to GTS in real time is ongoing.

Timothy Goos
Timothy Goos, Chairperson IABP
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REPORT BY THE WCRP-SCAR INTERNATIONAL PROGRAMME FOR ANTARCTIC BUOYS (IPAB)

No report had been submitted by the IPAB at the time of preparing this report.

REPORT BY THE INTERNATIONAL SOUTH ATLANTIC BUOY PROGRAMME (ISABP)

1. STATUS OF THE ACTION GROUP

The past biennium has been a successful period for the ISABP program.

Some of the accomplishments are listed below:

- There is a large operational network of fixed and drifting buoys, profiling floats and fixed stations providing data in real time over our area of interest to the operational, scientific and general communities;
- The number of drifters with barometric pressure in our area has increased;
- The amount of data and products available in the region have continued to increase;
- The capacity-building and training programs are underway;
- There is a high level of cooperation between participants; and
- New partners have joined the program.

In the last two years, the ISABP has attained a monthly average of almost 260 active drifters, a quarter of them with atmospheric pressure sensors. (Figure 1.)

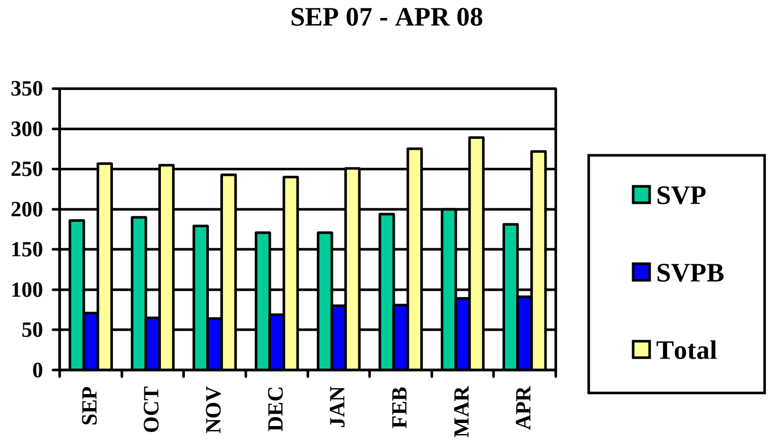

Figure 1: Active drifters per month

<u>Deployments in the ISABP region in the last 2 years</u>

Tropical Atlantic (20° S – 30° N)

- June 2006 - May 2007: SVP=180, SVPB=12, FOD (failed on deployment)=2; and
- June 2007 - April 2008: SVP=110, SVPB=14, FOD=8, SVPBW=4, SVPBS=5.

Extra Tropical Atlantic (40° S – 20° S)

- June 2006 - May 2007: SVP=18, SVPB=36, FOD=2; and
- June 2007 - April 2008: SVP=5, SVPB=1, FOD=1.

Note: not many deployments needed to maintain array here: this is a convergence region.

Southern Atlantic (60° S - 40° S)

- June 2006 - May 2007: SVP=25 SVPB=32, FOD=5; and
- June 2007 - April 2008: SVP=0, SVPB=56, FOD=2.

The Evolution of deployments in the South Atlantic Region (60S – 40S) between June 2006 – May 2007 and June 2007 – May 2008 show how the commitment for more barometric pressure measurements in the region has increased, thanks in part to the upgrade opportunity offered by GDP and to the purchases of more SVPBs by all participants. Deployments in the ISABP region from September 2007 – August 2008 are shown in Figure 2.

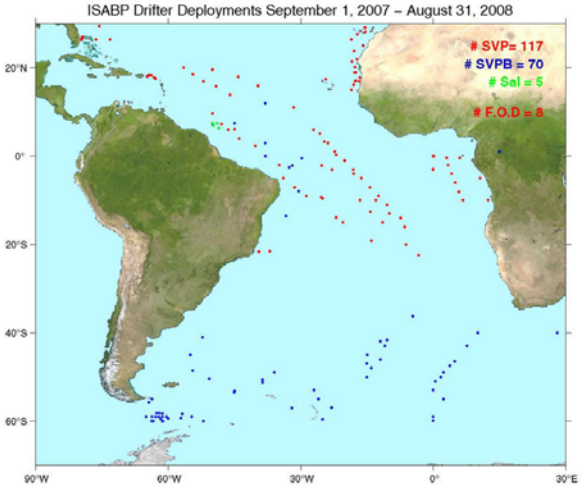

Figure 2

During the first semester of 2008, a total of 25 drifters have been deployed by the U.S. Navy in the Gulf of Guinea / Angola Basin (15 in January 2008 and 10 in June 2008), as part of a capacity-building initiative to provide training to the Western African nations, on XBT, drifter and Argo float and in an effort to populate this area of poor coverage.

Figure 3 shows the present status of the array in the ISABP region as of 11 August 2008.

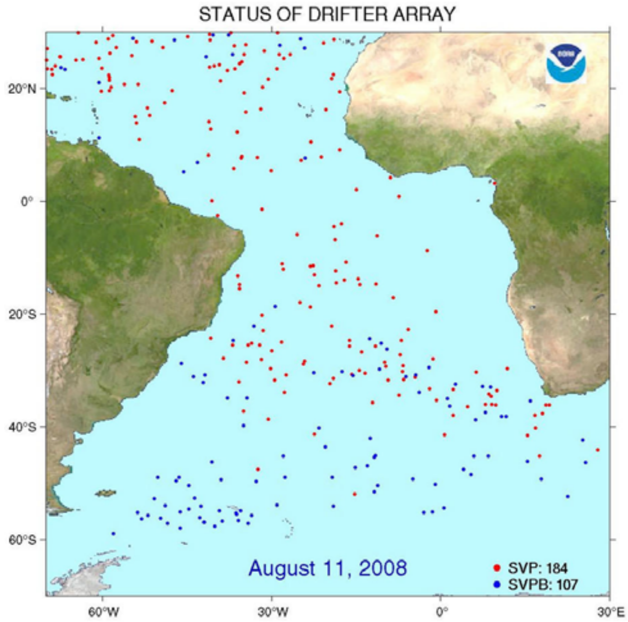

Figure 3

2. PLANS FOR NEXT YEAR

1 June 2008 - 31 May 2010

- Tropical Atlantic (30° N - 20° S): 360 drifters (50 SVPBs);
- Extra Tropical Atlantic (20° S - 40° S): 100 drifters (75 SVPBs); and

- South Atlantic (40° S - 60° S): 225 drifters (all SVPBs) these include ~100 upgrades by SAWS

3. MAIN ISSUES TO BE DISCUSSED AND RECOMMENDATIONS (AND / OR PROPOSED ACTIONS) TO THE PANEL

- The group recommended conducting studies with the objective of evaluating the impact of drifter pressure data, and eventually SST, on the skills of numerical weather forecasting models for the region of interest of ISABP;

- The group recommended holding next ISABP meetings back to back with the Upper Southwest and Tropical Alliance for Oceanography (OCEATLAN) whenever possible, pending approval from IOC on associated financial matters. It was also recommended to explore the possibility of having a joint OCEATLAN-ISABP scientific and technical workshop;

- The group supported the continuous efforts to cover observational gaps in the area of interest as well as the increase of the number of drifters with atmospheric pressure sensors;

  - The objectives and operating principles of the ISABP were updated;

  - It was suggested to create links in the ISABP website to the training CD produced by the Drifter DAC on drifter deployment, and how to access data and products from the web as well as links to the sites from where the data can be accessed and downloaded;

  - Contact prospective participants of ISABP during DBCP-XXIV;

  - Encourage the participation of students and junior scientists in the scientific and technical workshop.

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

Status and update on OceanSITES

This year saw a phase of renewed activity and initiatives in OceanSITES. Several major developments were implemented, some of them initiated or resulting from the prior DBCP meeting in 2007.

To start with, OceanSITES now has project office support via staff at JCOMMOPS (in particular part of Ms Hester Viola's time). The first step for this was funded by NOAA in the US, but continued operation will need matching funding of approx. $30K/year from other countries. A plan / hope is that countries already contributing to JCOMMOPS could slightly increase their funding, thus making unnecessary new administrative and political procedures. Since over ten countries currently contribute, a distributed addition for this would be minimal. This needs to be discussed at DBCP-XXIV and a procedure for this should ideally be established.

Another major development is that finally a second GDAC exists and has now started operating for OceanSITES. This is NDBC in the US, funded by NOAA, and together with Coriolis / France we now have the needed two GDAC's. The shared / combined manpower and expertise of these will make the work possible that is necessary to implement the data management and dissemination procedures.

A very constructive and successful meeting of the OceanSITES Steering Committee and Data Management Team was held in April 2008 in Vienna. Over 30 persons attended and contributed valuable expertise and initiative to the program. The following plans and decisions resulted from that meeting (for details, see the two reports from it):

- The data management structure (PI, DAC, GDAC) was refined and agreed, including allowed paths for data flow and types. All present members defined the DAC they would use for their data submission, and all those DACs were present and committed to their role;

- The OceanSITES data format was revised and approved, including catalogues, metadata, vocabularies and a range of other details. A trial period until September 2008 for the new format is now over, and all timeseries operators and DACs should now start the data flow to the GDACs;

- Two working groups were established to define a set of quality control procedures and best practices, for physical and biogeochemical data respectively;

- The CLIVAR data policy was formally accepted, and a document about OceanSITES data access was developed and approved at the request of CLIVAR / GSOP;

- The need for increased interaction and partnership with other communities was emphasized and action decided, e.g., collaborating with the carbon, surface current, wave, modeling, forecasting, satellite, and other communities;

- Products and indicators will be developed and implemented from OceanSITES data, and made available via the OceanSITES website;

- It is important to work towards enhanced homogeneity of the network of sites, in order to have more comparable measurements between more of the locations. To this end, a minimum set of core sensors was agreed on, which should be installed on as many as possible sites, but at least on a core/backbone system of approximately ten sites initially. The hardware cost of this was estimated to be in the order of 2Mio$. Additional volunteer manpower would be needed for installation and data processing.

- Funding for OceanSITES remains a difficult issue. Avenues being explored are via POGO / Ocean United, following up with various foundations, and via enhanced sharing of platforms, sensors, ship-time, and staff.

Oceansites does not have much updated information yet on the status of the network – this will be one of the first tasks for the new project office. Noteworthy developments nonetheless are the demise of NSF funded moorings at Hawaii and Bermuda, the ongoing implementation / operation of KEO and PAPA sites and their gradual support by NOAA, the EuroSITES program having entered its fully active phase, and the NSF OOI program still being a potential contributor but in uncertain waters. In addition, the Indian Ocean is seeing a huge amount of activity, both by Indian agencies and NOAA/PMEL. A complete and new system status update will be available within the year.