WORLD METEOROLOGICAL ORGANIZATION	INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)
JOINT WMO/IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY (JCOMM) **SHIP OBSERVATIONS TEAM (SOT)** **EIGHTH SESSION**	SOT-8 / Doc. 3.2 (14.04.2015) ITEM: 3.2
CAPE TOWN, SOUTH AFRICA, 20-24 APRIL 2015	Original: ENGLISH

REPORT FROM THE OBSERVATIONS PROGRAMME AREA COORDINATOR

(Submitted by David Legler (USA), and David Meldrum (United Kingdom), co-Chairs. Observations Coordination Group (OCG))

Summary and purpose of the document

This document contains a report from the co-Chairs of the JCOMM Observations Coordination Group (OCG), outlining goals and progress made towards: achieving global coverage by the *in situ* networks, system-wide monitoring and performance reporting, and funding to meet implementation targets.

ACTION PROPOSED

The Team 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.

References:

JCOMM-4 Session Report (Yeosu, Republic of Korea, 28-31 May 2012), WMO-IOC/JCOMM-4/3, WMO No. 1093.

Final report, Fifth Session of the JCOMM Observations Coordination Group (OCG), Silver Spring, USA, 5-7 September 2013, JCOMM Meeting Report No. 107.

Appendices: **A.** OCG-5 action items of interest to the SOT
B. Future Priority for OPA (JCOMM-4 report agenda item 6.4)
C. JCOMM Observing System Implementations Goals (May 2012)
D. Future tasks for the OCG (Sep 2014)

- A - DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

3.2.1 The Co-chairs of the JCOMM Observations Coordination Group (OCG), Dr David Legler (USA) reported on JCOMM Observations Programme Area (OPA) issues of interest to the SOT. He recalled that the Implementation Goals for the OPA are based on the WMO-IOC-UNEP-ICSU Global Climate Observing System (GCOS) Implementation Plan for Climate (GCOS-IP) are designed for climate but also serve global and coastal ocean prediction, marine transportation, marine hazards warning, marine environmental monitoring, naval applications, and many other nonclimate users.

3.2.2 Dr Legler reported that the global system has remained about 62% complete for several years, as measured against the implement targets identified in the GCOS IP; and that new resources will be necessary to advance system-wide implementation in deployment of data buoys, profiling floats, tide gauge stations, and ship-based systems.

3.2.3 Dr Legler recalled the priority activities decided by JCOMM-4 (Yeosu, Republic of Korea, May 2012) for the OPA until JCOMM-5 (November 2017) and encouraged SOT to address the actions to be addressed by JCOMM-5; and more importantly, to begin preparations for JCOMM-5 by undertaking/completing tasks leading to new capabilities and progress that can be highlighted at JCOMM-5. It was noted that this will also be subject of some discussion at OCG-6. The Team requested the SOT Technical Coordinator to review the JCOMM-4 actions that are for the SOT to address, to remind the relevant actors about such actions, and to seek feedback from them in the view to refine the SOT action plan up to JCOMM-5 (***action; M. Kramp; Jul. 2017***).

3.2.4 Further discussions and specific recommendations and actions were addressed during specific agenda items.

3.2.5. The Team recalled that the consistent use of unique ship identifiers would greatly aid tracking and reporting of ship-based measurements for many purposes. The OCG requested SOT to explore and identify practical solutions in planning for WIGOS to address the need for 1) JCOMMOPS to track ship-based observations and associate correct metadata to reported observations; and 2) the climate community to trace ship observations reports to unique hulls. The Team requested the Technical Coordinator to coordinate this action (***action; SOT; end 2015***).

3.2.6. The Team noted that there are multiple requirement-documenting processes underway under GCOS, GOOS, and WIGOS/WMO-RR. OOPC and OCG are undertaking an effort to document requirements and capabilities by network (e.g. SOT/VOS) and by variable. The OCG requested continued cooperation of SOT in participating in these processes in order to fully describe and map requirements and capabilities in order to identify gaps and synergies. The Team therefore requested the SOT, VOSP, and SOOPIP Chairs to contribute to this effort and coordinate with their Team as needed (***action; SOT, VOSP & SOOPIP Chairs; asap***).

3.2.7. With the commissioning of the new JCOMMOPS Centre in Brest on March 18, 2015, the Team agreed that planning is continuing to fully exploit the synergies and resources of this Centre in support of ocean observing activities and monitoring ocean observing system performance. During OCG-6 JCOMMOPS work plans will be reviewed and approved to guide JCOMMOPS efforts over the next two years. OCG requests continued engagement by SOT leadership in this process. Furthermore, SOT should continue to seek additional financial support of JCOMMOPS, and the Team requested its members not already contributing to JCOMMOPS to discuss nationally and consider providing such support in the future (***action; SOT members; SOT-9***).

3.2.8. There are several recommended actions made in the recent report to JCOMM (see website[1]) to improve data management practices across the OPA to improve real-time accessibility and interoperability. The Team concurred with the OCG request for undertaking a review of the these recommendations and for encouraging actions in response. The Team requested the SOT

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[1] http://jcomm.info/index.php?option=com_content&view=article&id=331

Chair to lead this effort (***action; SOT Chair; asap***). Progress will be reviewed during OCG-6.

- B - BACKGROUND INFORMATION

1. The SOT contribution to GOOS and GCOS comes from the Voluntary Observing Ship (VOS) scheme, including the VOS Climate (VOSClim) part and from the Ship of Opportunity Programme (SOOP) network of XBT lines. These SOT contributions are central to the global ocean system operations, not only because of the met-ocean data sets delivered from voluntary observing ships, but also because the voluntary fleet provides the platforms of opportunity necessary for deployment of the drifting arrays, and the platforms of opportunity that support underway carbon dioxide air-sea flux measurements. Metrics to clearly measure progress are important to sustaining an integrated observing system, and are being automatically incorporated into the JCOMM Observing System Monitoring Center (OSMC). VOSClim and the SOOP Implementation Panel (SOOPIP) are commended for progress made in this area, and are encouraged to continue in this effort, especially to align with the Framework for Ocean Observing (FOO) focus on Essential Ocean Variables (EOV). The development of metrics for the VOS fleet and GO-SHIP programme are also encouraged.

2. An important element of the observing system is the technical support from the JCOMM *in situ* Observations Programme Support Centre (JCOMMOPS). While financial support for JCOMMOPS remained fragile and fragmentary, the Ship Coordinator’s position established as a pilot project has been successful thanks to the recruitment of Mr Martin Kramp in that position in 2013. It is now planned to establish the position for the long term. The Ship Coordinator’s position combines the technical coordinator function for the SOT and GO-SHIP with activities dedicated to securing and coordinating vessels for deployment. Additional contributions are necessary to continue this success.

3. The Fourth Session of JCOMM (JCOMM-4, May 2012, Yeosu, Republic of Korea) called on the OPA to proactively engage and establish dialogue with requirements-setters to set realistic priorities; recruit additional Members / Member States as well as ocean observing communities and industry fora to contribute to the observing system; develop pilot projects for new sensors and synergies between observing system elements; continue capacity development activities; and encourage and document observing and data management standards and best practices. JCOMM-4 also made specific requests to support GO-SHIP and continue dialogue with other shipbased activities such as those associated with the World Ocean Council.

Appendices: 4

APPENDIX A

Excerpt of the actions items arising from OCG-5 (Silver Spring, USA, 5-7 September 2013), which are of interest to the SOT

No.	***Ref.***	***Action item***	***By whom***	***Deadline***	***Status***
2	1.2(2)	to refine the metrics so that they are able to show the actual evolution of the observing systems	OSMC	OCG-6	Some progress to be further discussed at OCG-6
4	1.2(6)	to review the report on data flow of Bob Keeley (Katy to define process with Candyce, and divide up review between OOPC Members. Katy to collate. Review to Bob by Mid November). DMPA to be involved.	K. Hill, R. Kelley, S. Iona	Nov. 2013	Report published (see website).
5	1.2(7)	to initiate discussions regarding establishing better links between the OOPC and the SFSPA in order to better take into account the requirements for ocean application (marine services, ocean forecasting, etc.) to feed eventually into the OPA Implementation Goals.	OOPC	asap	Statement of Guidance for Ocean Applications updated in March 2014 by the JCOMM/SFSPA Point of Contact (Guimei Lui, China) through the WMO Commission for Basic Systems. SoG available on the WMO website.
10	2.2.4	to appoint an editor of these two guides (1: marine meteorological observing practices; and 2: ocean observing practices) to set the framework and develop a work plan for encouraging observing network teams to review and update their appendices	Co-Presidents & secretariat	OCG-6	Waiting for feedback from NCOSM (China), which is coordinating the activity. To be discussed at OCG-6
11	3.1.22	to develop best practices for new ship design, taking into account relevant developments at IMO (eNav etc.), in collaboration with the ICS and IACS, in the view to eventually submit related recommendation to the IMO	SOT	OCG-6	Limited progress; to be discussed at SOT.8.
12	3.1.23	to provide information that would help OCG, AOPC, and OOPC make the case	VOSP	OCG-6	VOS template drafted and to be reviewed by SOT and VOSP.

No.	***Ref.***	***Action item***	***By whom***	***Deadline***	***Status***
		(balancing feasibility including cost and impact) to Members/Member States for a sustained and/or evolved VOS network (e.g., balance between automated and manual observations), using the observing network template that identifies the unique characteristics of the observing network			Other documents: (i) SOT Implementation Strategy (JCOMM TR No. 61 to be updated by SOT-8, and (ii) VOS Framework document (JCOMM TR No. 4, Rev2) to be revised by SOT-8
15	3.1.39	to compile information about the evolution of the observing networks in order to visualize with new graphical products the *trends of gaps of the arrays*. Such tools will in particular be useful to the OOPC for making its recommendations to JCOMM	JCOMMOPS	OCG-6	
16	3.1.40	to develop concepts for pilot projects linking observing with a services component	G. Mitchum, D. Legler, A. Fischer	OCG-6	
20	4.3.4	to organize a first teleconference and facilitate future calls regarding preparing a menu of options for the shipping industry and defining a strategy to engage them through the IMO, International Chamber of Shipping, and other organizations	M. Kramp	asap	
24	5.2.1	to develop its workplan, including (i) the general (synergetic) part, and (ii) the workplans developed by each Panel (DBCP, Argo, SOT, OceanSITEs, GO-SHIP), for regular review by the JCOMMOPS Roundtable	JCOMMOPS	OCG-6	Done and to be discussed at SOT-8.
25	5.2.2	to further develop a long-range JCOMMOPS Strategy to provide services in support of JCOMM ocean observing networks	OCG Chair & Secr.	OCG-6	Initiated through series of JCOMMOPS roundtable teleconferences.
27	5.2.4	to make a proposal to the OCG chair regarding some principles on the type and	JCOMMOPS	OCG-6	Discussed through JCOMMOPS roundtable teleconferences.

No.	***Ref.***	***Action item***	***By whom***	***Deadline***	***Status***
		level of services to be provided by JCOMMOPS to the Panels and the associated groups taking into account the different levels of commitments of each Panels			
28	5.3.2	to provide a quantitative (vs. qualitative) analysis of pros and cons of moving JCOMMOPS to Brest vs. keeping it in Toulouse: e.g. to include information on the cost of moving the staff; on the impact on productivity; on what the IFREMER rent is going to be (commitment of IFREMER to be documented).	JCOMMOPS	OCG-6	Done. JCOMMOPS has been moved to Brest.
29	5.3.3	to seek commitment letters from IFREMER and CLS if JCOMMOPS has to be based in Brest	JCOMMOPS	asap	Done. JCOMMOPS has been moved to Brest.

APPENDIX B

FUTURE PRIORITY FOR THE OBSERVATIONS PROGRAMME AREA

(Excerpt from the General Summary of JCOMM-4)

6.4 FUTURE PRIORITY FOR THE OBSERVATION PROGRAMME AREA *(agenda item 6.4)*

6.4.1 The Commission noted its potential role in the emergence of Africa in the domains of oceanography and marine meteorology, through the development of synoptic observations. It recognized that Africa was ready to face a number of challenges to human security through marine scientific research, and recognized the ambition of young African researchers wishing to work in oceanography and marine meteorology. Africa was ready to contribute through the involvement of the navies and other national agencies of Members / Member States who could support climate research and operational oceanography by the installation of real-time observing networks in coastal and the high seas, assuring their security and maintenance. The Commission recognized that it could provide a way to attract more coastal African states to its programmes and activities, and urged developed Members / Member States to cooperate with African Members / Member States in the framework of equitably shared operational programmes.

6.4.2 The Commission endorsed the future priority activities for the next intersessional period for the Observations Programme Area (OPA), as proposed by the Observations Coordination Group (OCG). These are described below, in no particular order:

a) Contribute to WIGOS Implementation;

b) proactively engage and establish dialogue with requirements setters and writers of implementation plans (such as OOPC, the WMO RRR, and the GFCS) to set realistic priorities for the future composite ocean observing system, establish practical ways of moving forward, and together seek routes for funding;

c) recruit additional Members / Member States, institutions and agencies, in a way that allows their activities to progress on their own priorities and to contribute to the global observing effort;

d) identify other ocean observing communities (e.g. ocean glider operators) and marine industry fora (e.g. the World Ocean Council) that might be recruited to extend the scope and capability of ocean observation;

e) develop synergies between observing systems to exploit the potential of joint deployment opportunities, and to foster a common approach to sensor development and best practices;

f) develop pilot projects as a means towards the rolling out of the new platforms, sensors and technologies that will in due course become routine components of the observing network;

g) continue capacity development activities, including training workshops, that will assist developing countries to better use ocean products and to participate more fully in the global observing effort;

h) encourage identification and implementation of observing standards and best practices, with particular focus on developing countries, including through encouraging JCOMM members to offer new Regional Marine Instrumentation Centre (RMIC) facilities; and

i) continue to document institutional data and meta-data management practices for each component of the observing system to advance consistent, climate-quality, seamless data delivery both in near real time and delayed mode.

APPENDIX C

JCOMM OBSERVING SYSTEM IMPLEMENTATIONS GOALS (MAY 2012)

JOINT WMO-IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE
METEROLOGY (JCOMM)
OBSERVATIONS PROGRAMME AREA (OPA)
IMPLEMENTATION GOALS (OPA-IG)

(as noted by the fourth JCOMM Session, Yeosu, Republic of Korea, 21-31 May 2012)

1. INTRODUCTION

The Observations Programme Area (OPA) work plan is aligned with the ocean chapter of the GCOS *Implementation Plan for the Global Observing System for Climate in support of the UNFCCC* (GCOS-138 in its 2010 update). The implementation goals provide specific implementation targets for building and sustaining an initial global ocean observing system representing the climate component of the Global Ocean Observing System (GOOS) and the ocean component of the Global Climate Observing System (GCOS). Although the baseline system proposed under the implementation goals was designed to meet climate requirements, non-climate applications, such as NWP, global and coastal ocean prediction, and marine services in general, will be improved by implementation of the systematic global observations of Essential Climate Variables (ECVs) called for by the GCOS-138 plan.

Sixty-two percent of the initial composite ocean observing system is now completed (Figure 1), and three components have achieved their initial implementation target: the drifting buoy array (at JCOMM-II, in September 2005), the Argo profiling float programme (November 2007), and the VOS Climate Project fleet (June 2007).

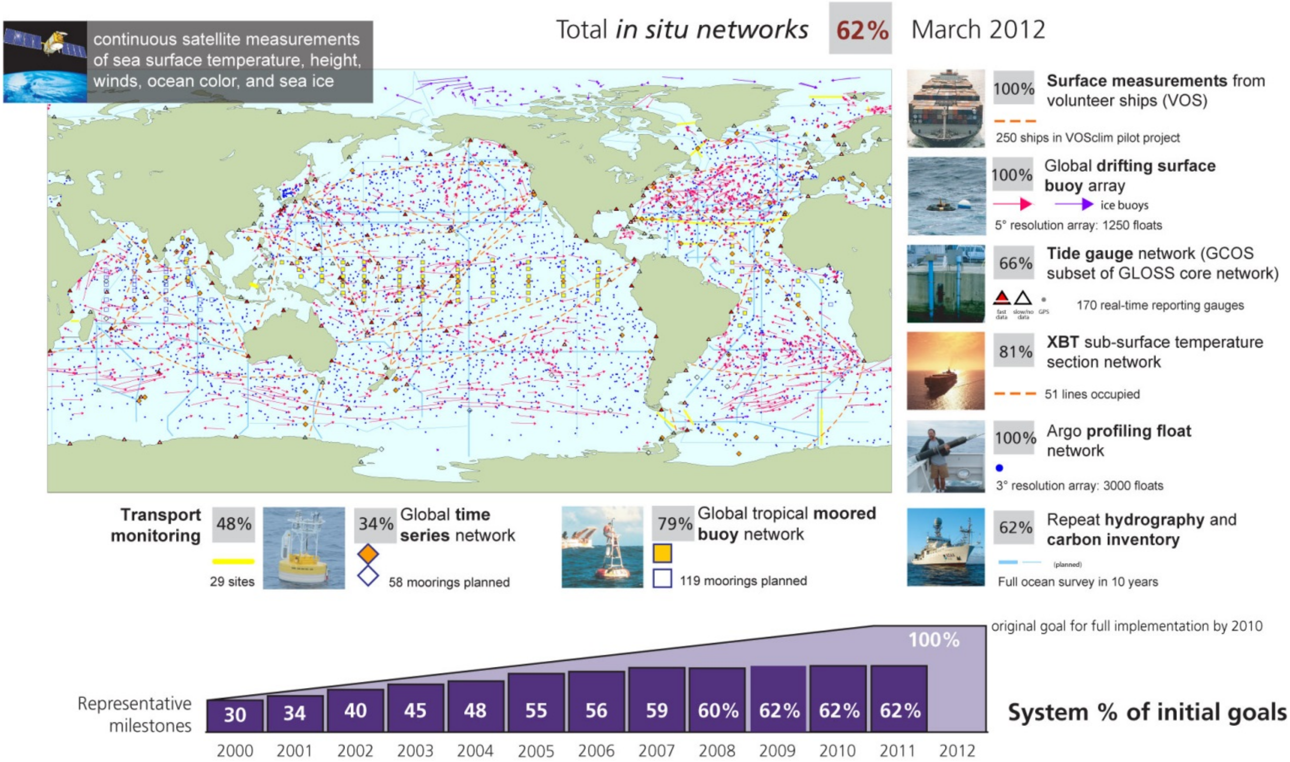


Figure 1 – A schematic of the initial composite ocean observing system design, including the current status against the goals of the GCOS Implementation Plan 2010 (GCOS-IP).

2. DATA BUOY COOPERATION PANEL (DBCP)

Implementation Goals	• Sustain global coverage (each 5x5 degree region outside the near-equatorial band) of the drifting buoy array (total array of 1250 drifting buoys equipped with ocean temperature sensors), and obtain global coverage of atmospheric pressure sensors on the drifting buoys • Complete implementation of and sustain the Tropical Moored Buoy network of 125 moorings in the Pacific, Atlantic, and Indian Oceans
Metrics now used by OCG	• number out of 1250 drifting buoys, as reported on the GTS • number implemented out of 125 tropical moored buoys, as reported on the GTS

2.1 Overview of DBCP activities

At its inception in 1985, the DBCP was charged with improving the quantity, quality and timeliness of data buoy observations from the global oceans, and with persuading the research community to make their considerable body of data available in near real time for use by the global forecasting community (i.e. data formatting and insertion on to the GTS). Success in this area was achieved through the employment of a Technical Coordinator (TC) and the creation of a number of regional and application-specific Action Groups (currently eleven in number) that were able to coordinate their activities under the general guidance of the DBCP. By 2000, the initial objectives laid before the Panel had largely been met and become routine, and the Panel gradually turned towards the identification of new challenges that would pave its way forward and make best use of the skills, knowledge base, resources and goodwill, that the Panel enjoyed and could exploit in developing data buoy activities worldwide.

Central to the new working practices of the DBCP are four key elements:

- The creation of an Executive Board, supported by a number (currently five) of focused task teams, to ensure that the mission of the Panel could progress effectively during the intersessional period;
- The sponsoring of Pilot Projects to evaluate in detail emerging technologies that might ultimately enhance the capabilities of data buoy networks;
- The initiation of outreach and Capacity Building activities both to enable developing regions to successfully implement and manage data buoy programmes, and to assist the Panel in recovering increased numbers of buoy observations from data-sparse areas. This approach is consistent For example, the Panel ran two successful training workshops for key regional participants in 2011 and 2012, and has an active task team to take matters forward;
- The streamlining of the Panel’s annual sessions to make better use of participants’ time and experience by concentrating on those issues that require the Panel’s attention and decision.

In common with many other observing networks, the mission of the DBCP can only be achieved through the employment of its TC. The retention of the TC is vital to the success of the Panel, and there are a number of difficulties to be overcome in this regard.

The issue of inadequate deployment opportunities is now the major difficulty affecting the global dispersion of the drifter array, an issue which is shared with the Argo programme. The Southern Ocean, Gulf of Guinea and the NW Indian Ocean continue to prove particularly troublesome. The DBCP and Argo TCs are working together to identify shared deployment cruises, and the solidified SOT/vessel coordinator position will strengthen this ability.

In measuring performance against requirements, in all three areas (quantity, quality and timeliness of observations) the trend in performance is one of steady improvement. Where there are instances of the trend not being followed (e.g. in the regional distribution of buoy coverage, or in regional anomalies in data timeliness), the Panel is notified by its TC and suitable remedial actions agreed where possible.

Until recently, the numbers of buoys reporting data on the GTS was exceeding the target of 1250 specified in the OPA implementation goals (see Figure 2), There is a dip in the numbers (1205 for February 2012) having to do with lower lifetimes of drifters. It is important to note that nearly 50% of the drifters on the GTS now report atmospheric pressure, in large measure that is a tribute to the barometer upgrade scheme operated by the Global Drifter Programme that has successfully encouraged the addition of barometers to standard SST-only drifters (SVPs). Figure 3 shows the global distribution of both moored and drifting buoys, with the Tropical Moored Buoy array clearly evident. Figure 4 shows the distribution of air pressure observations and the lack of data from the tropics (an intentional gap, as the pressure signal from this region is in general weak). Recently expressed user requirements indicate that this coverage needs to be improved.

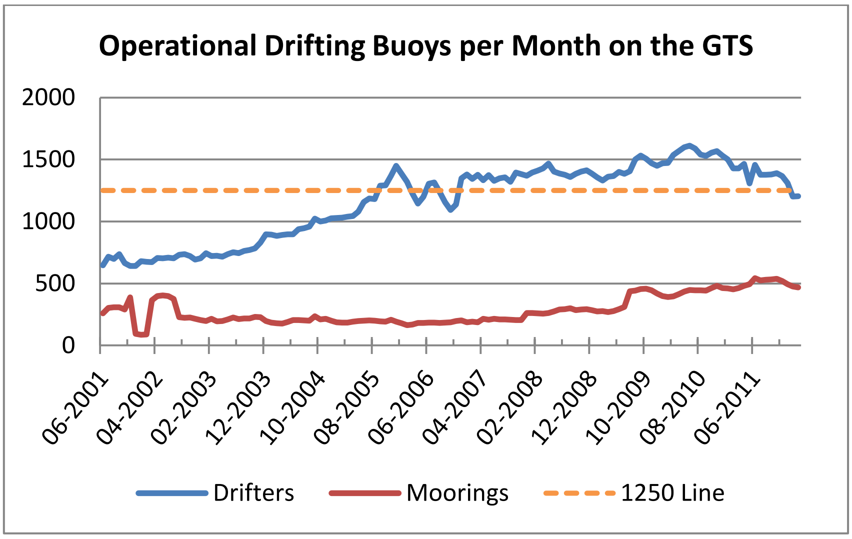


Figure 2 – Monthly evolution of the number of operational drifting buoys reporting on GTS from June 2001 to February 2012. Operational moored buoys are also included (Data derived by statistics computed from GTS in situ marine data provided by Météo-France – Source: JCOMMOPS).

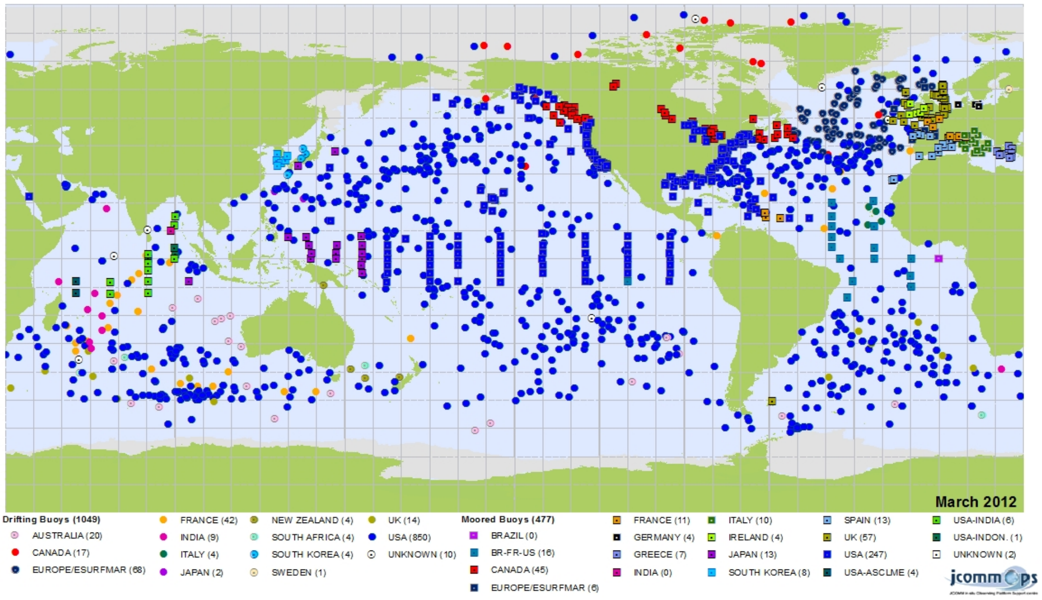


Figure 3 – Total numbers of buoys (moored and drifting) reporting on the GTS in March 2012 (Source: JCOMMOPS).

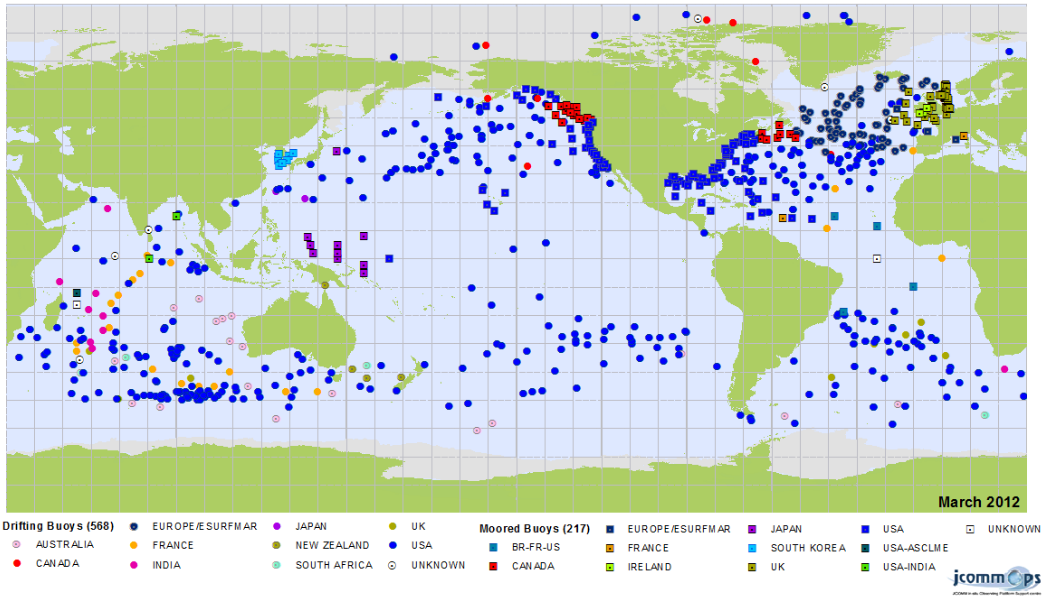


Figure 4 – DBCP barometer buoy monthly status by country for March 2012 (data buoys reporting pressure on the GTS via Météo-France – Source: JCOMMOPS).

Figure 5 shows the evolution of the Tropical Moored Buoy Array between October 1999 and April 2012. The programme has grown substantially in scope and capability since the community wide survey of ocean measurements as part of the OceanObs’99 Conference, in 1999. New challenges and opportunities exist to build on successes over the past 10 years. Most critical is the need to complete the network and maintain climate quality time series in all three ocean basins for the future. The Prediction and Research Moored Array in the Tropical Atlantic (PIRATA) has expanded and been enhanced since 2005. The Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA) was initiated in the Indian Ocean (beginning in 2000) and is now about 65% complete, Flux Reference Sites were established in all three oceans (beginning in 2005) as part of OceanSITES, and additional biogeochemical measurements were added in the Pacific and Atlantic (beginning in 2003).

In general, the quality of buoy observations (moored and drifting) continues to improve, as measured by the deviation from background fields or by the numbers of observations ingested by NWP models. The quality of wind spectral data from moored buoys continues to be an area of concern, and the Panel has joined with the JCOMM Expert Team on Wind Waves and Storm Surges (ETWS) to initiate a pilot project to examine ways of making improvements in this area .

The delays between the time of an observation and its publication on the GTS continues to improve, both through the extension of the Argos regional antenna network and the increasing use of Iridium as a communications channel, stimulated in part by the DBCP Iridium Pilot Project. Nonetheless, improvements can still be made (e.g. Tropical Moored Buoy array, and in the S Atlantic and S Pacific) through: (i) connecting more Local User Terminals to the Argos System; and (ii) fixing the ongoing blind orbit issue caused by the non-optimal geographic distribution of global ground stations for the NOAA polar orbiters that carry the Argos payload.

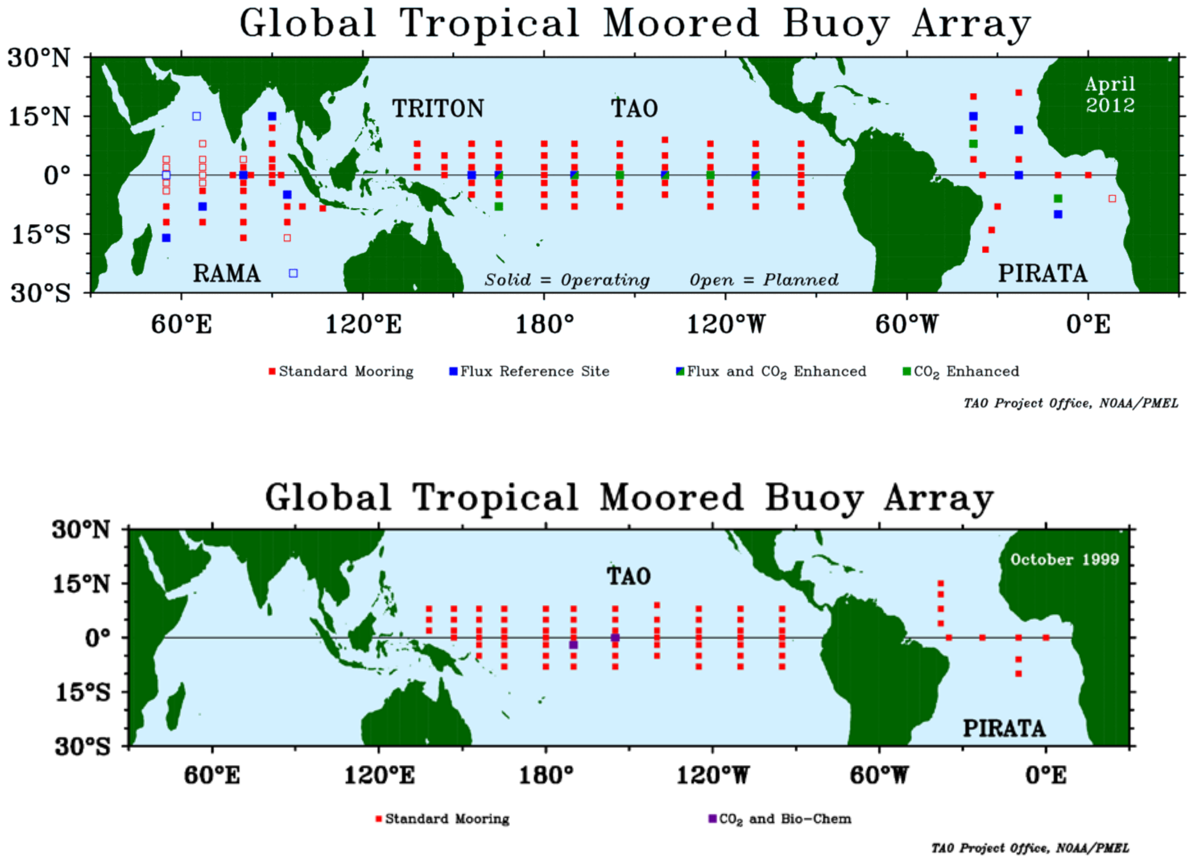


Figure 5 – The global tropical Moored Buoy Array in April 2012 (top) and October 1999 (bottom) (Source: NOAA/PMEL, USA).

3. SHIP OBSERVATIONS TEAM (SOT)

3.1 Overview of SOT activities

The Ship Observations Team (SOT) was created to build on synergies between the three Panels involved in coordinating global ship-based observing programmes: the Voluntary Observing Ship (VOS) Scheme, the Ship-Of-Opportunity Programme (SOOP), and the Automated Shipboard Aerological Programme (ASAP), with a view to an eventual possible full-integration of ship-based observing systems on commercial and research vessels.

Progress has been made to integrate the three programmes under one umbrella, although monitoring and coordination of SOT activities has been limited during the intersession period due to not having a dedicated Technical Coordinator. This situation will change in 2012 with a pilot project to combine the TC functions with activities of a “Ship Logistics Coordinator” dedicated to securing and coordinating vessels for deployment of multi-platform observing system activities.

The efforts of the SOT have resulted in a more cost-effective way of collecting observations through observing systems that are now better standardized and addressing a wide range of meteorological and oceanographic applications. Because of the ongoing commitments and the dedication from Members/Member States, a number of challenges have been successfully addressed through the SOT:

- Consideration of requirements from a wide range of users (e.g. NWP, climate applications, OOPC, marine climatology, ocean modelling, satellite validation and bias correction, GHRSST);
- Completion of the VOSClim network, and its integration into the wider VOS;

- Strong collaboration with the DBCP in supporting and benefiting from the JCOMMOPS office facilitating ship networks monitoring, the resolving of technical issues, and the use of ship opportunities for the deployment of drifters;
- Close relationships with associated programmes making ship observations such as the International Ocean Carbon Coordination Project (IOCCP), the Shipboard Automated Meteorological and Oceanographic System Project (SAMOS), the Ferrybox Project, the SeaKeepers Society, the Alliance for Coastal Technologies (ACT), and the SCOR/IAPSO OceanScope Working Group;
- Addressing ship owners and masters concerns with regard to availability of VOS information on public websites. This led to the WMO Executive Council adopting Resolution 27 (EC-LIX) authorizing Members to implement ship masking schemes. The SOT has been coordinating the different masking schemes proposed, and made sure that the user requirements could continue to be met;
- Routine collection of ship metadata through the management of WMO-No. 47, and strong collaboration with the Water Temperature metadata Pilot Project (META-T) for the delivery of ship metadata in real time via BUFR reports;
- The undertaking of Capacity Building activities, including the organization of a fourth international workshop for Port Meteorological Officers (Orlando, USA, December 2010);
- Reviewing satellite data telecommunication systems, and the testing and evaluation of Iridium for the transmission of marine/ocean observations from ships;
- Addressing instrument standards, and the conduct of e-logbook intercomparisons leading to specific recommendations being made to improve coherence and quality of the data;
- Addressing the recruitment of ships in times where the shipping industry is facing economic difficulties, where ships are changing routes, staff, and owners.

3.2 Voluntary Observing Ship (VOS) scheme

Implementation Goal	Improve number and quality of climate-relevant marine surface observations from the VOS. Improve metadata acquisition and management for as many VOS as possible through VOSClim, together with improved measurement systems.
Metric now used by OCG	Number out of a target of 250 ships in the VOSClim Fleet (proposed future metric of 25% of VOS in VOSClim Fleet), with metadata reported in WMO Pub. 47

The VOS Scheme (see http://www.bom.gov/au/jcomm/vos/) is a unique network in that does not have a target network size, primarily because it depends on the support of commercial shipping companies that are subject to commercial/financial pressures (including sale, re-routing and scuttling). The VOS Scheme consists of national VOS fleets (VOF), each of which consists of a mix of commercial, research, fishing, passenger and private vessels. VOS data support a wide range of applications, including: the analysis of weather systems and storm tracking and the provision of high quality maritime safety services; NWP and local weather forecasts; ground-truthing of satellite derived data; validating coastal and island observations; climate research, modelling and forecasts. In addition, VOS data support other industries and users including: fishing, transport, coastal engineering, search and rescue, marine pollution, offshore drilling and mining.

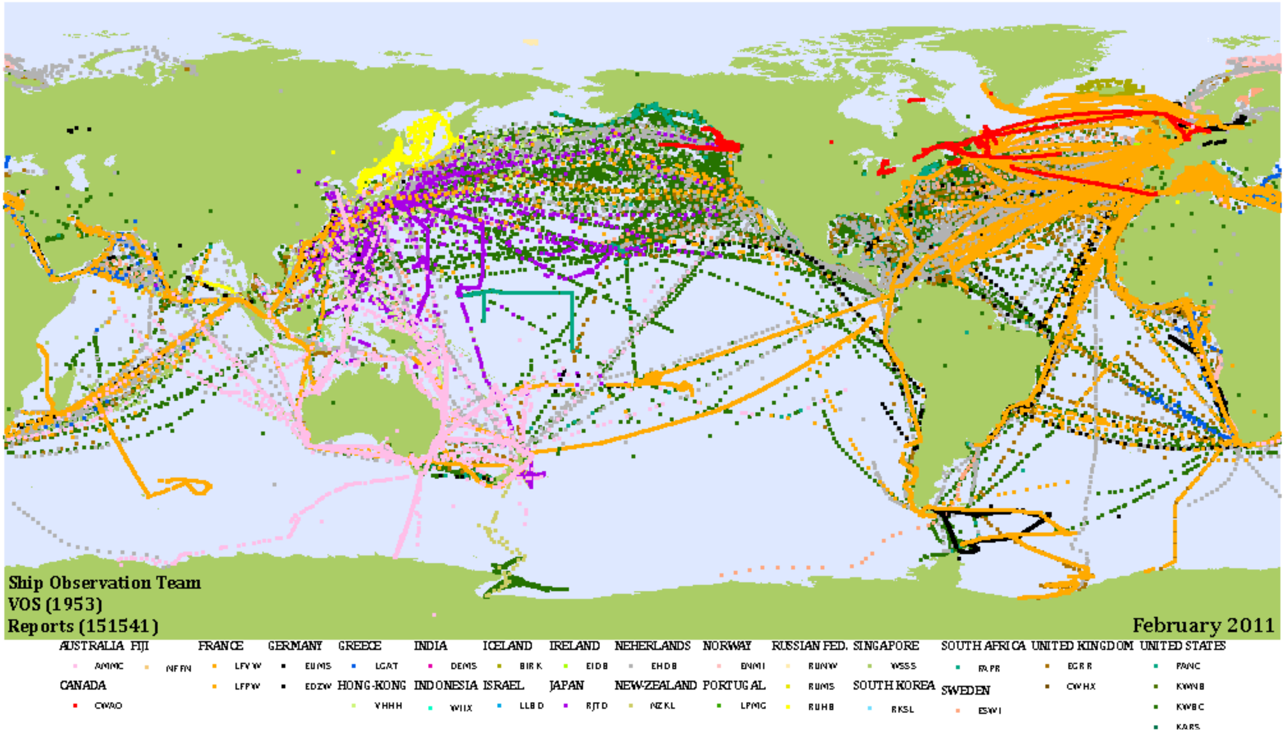


Figure 6 – VOS reports received by Météo-France by GTS origin, February 2011 (source: JCOMMOPS).

On average, in excess of 100,000 VOS reports from more than 2,000 ships are distributed on the GTS per month (see Figure 6), predominantly in the Northern Hemisphere. Delayed-mode meteorological data, i.e. observational data in an electronic logbook or the traditional paper logbook are also routinely collected as part of the Marine Climatological Summaries Scheme (MCSS) and distributed to the Global Collection Centres (GCCs) in the UK and Germany. Metadata relating to the individual ships and the installed meteorological equipment and observing program are collected by a Port Meteorological Officer (PMO) at recruitment and updated as required at subsequent inspection visits. Metadata in support of WMO-No. 47 are requested from Members/Member States every quarter.

VOSClim has evolved into the preferred meteorological class of reporting ship to maintain on ongoing network of Climate Reference Ships, with a goal of 25% of the VOS fleet achieving that status. The VOS Ancillary Pilot Project, aimed at allowing a greater number of ships to join the global VOS Scheme without some of the constraints of being part of a national VOS fleet, will continue their work with a view to add a new class of reporting vessel in the next intersessional period.

VOS Programme Managers receive monthly monitoring reports from the Regional Specialized Meteorological Centre (RSMC) in Exeter (UK), and the VOSClim Real Time Monitoring Centre (RTMC), also operated by the UK. VOS Programme Managers and PMOs can also perform near real-time monitoring of their ships with the VOS Monitoring Tools provided on the Météo-France website.

The global VOS is underpinned by the international PMO network, which plays a crucial role in ship recruiting, training of observing staff and calibration of the instruments. Fixed budgets and increasing costs are affecting the ability of some Members/Member States to maintain adequate levels of serviceable equipment. To address these challenges, the fourth PMO workshop launched two initiatives: i) the PMO Buddy Programme to match experienced PMOs with less experienced ones to share practical knowledge; and ii) the VOS Donation Programme to install a buoy on the deck of a ship to act as an autonomous self-contained AWS for countries wanting to start VOS activities.

3.3 Ship of Opportunity Programme Implementation Panel (SOOPIP)

Implementation Goal	Sustain the Ship-of-Opportunity XBT/XCTD transoceanic network of 51 sections
Metric now used by OCG	Number of yearly XBT profiles taken out of 37 000 (needed to sustain the network), as reported on the GTS

The Ship of Opportunity Programme (SOOP) addresses both scientific and operational goals for building a sustained ocean observing system with oceanographic observations mainly from cargo ships. These observations are mainly obtained from eXpendable BathyThermographs (XBT), but also from eXpendable Conductivity Temperature Depth (XCTD), Acoustic Doppler Current Profilers (ADCP), ThermoSalinoGraphs (TSG), Continuous Plankton Recorders (CPR). Presently, only the XBT programme is based on recommendations from international and regional panels, and involves repeat sampling at more or less regular intervals along pre-determined routes (transects).

XBT operations are the main component of the SOOP. There are two modes of spatial sampling: Frequently Repeated (FR, 12-18 transects per year and 6 XBT deployments per day), and High Density (HD, 3 to 5 transects per year, 1 deployment every 10-50 km). The accomplishment and maintenance of the OceanObs'09 recommended transects (Figure 7 and Table 1) are highly dependent on funding, ship traffic, and recruitments. However, similar to the Volunteer Observing Ships (dedicated to meteorological observations), the SOOP is currently encountering problems in achieving its objectives primarily because of unforeseen ship route changes or the suspension of trade on some routes.

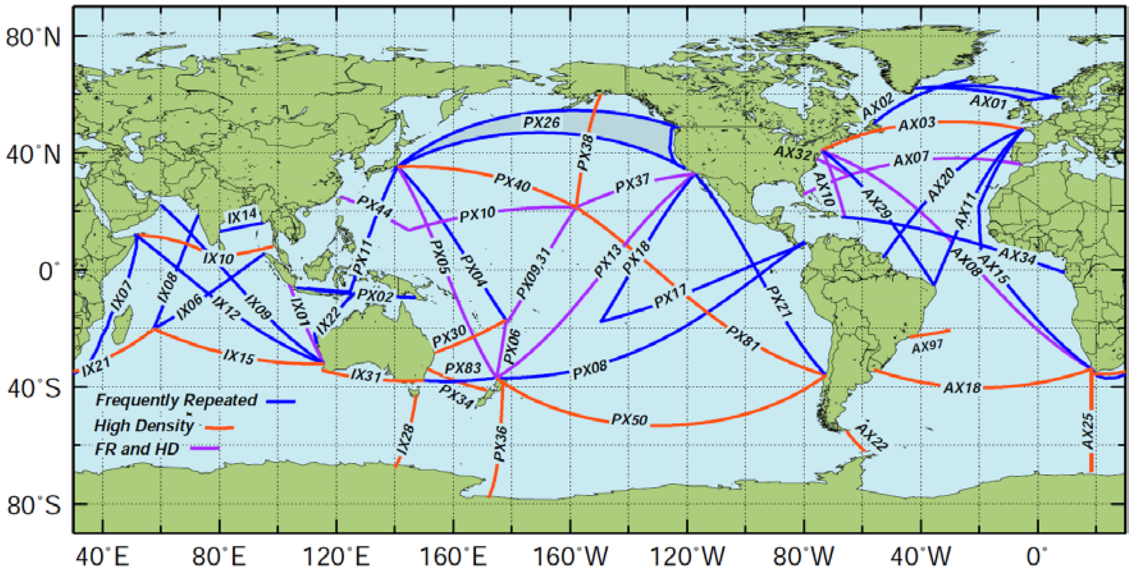
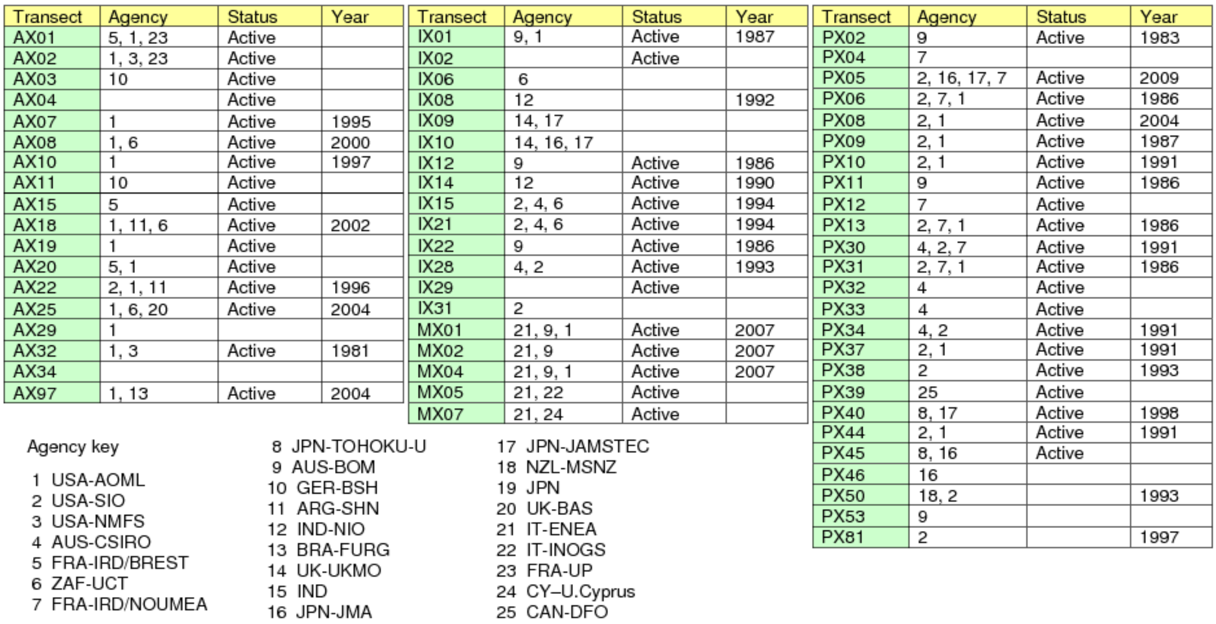


Figure 7 – Location of the High Density and Frequently Repeated XBT transects recommended by OceanObs'09 (above) and countries leading the efforts to carry out each transect (below).

SOOP addresses both scientific and operational goals for building a sustained ocean observing system. XBT observations represent approximately 25% of the upper ocean thermal observations. The main objective of XBT observations are linked specifically to the three modes of deployment. Data along fixed transects are of critical scientific value and used to (1) investigate for example intraseasonal interannual variability in the tropical ocean (Low Density mode), (2) measure seasonal and interannual variation of volume transport of major open ocean currents (Frequently Repeated Mode), and (3) measure meridional heat advection across ocean basins (High Density mode). During the last decade the goal of XBT observations has shifted from the monitoring of the upper ocean thermal structure to investigating the variability of critical surface and subsurface currents using High Density XBT observations along repeat transects.



Transect	Agency	Status	Year
AX01	5, 1, 23	Active	
AX02	1, 3, 23	Active	
AX03	10	Active	
AX04		Active	
AX07	1	Active	1995
AX08	1, 6	Active	2000
AX10	1	Active	1997
AX11	10	Active	
AX15	5	Active	
AX18	1, 11, 6	Active	2002
AX19	1	Active	
AX20	5, 1	Active	
AX22	2, 1, 11	Active	1996
AX25	1, 6, 20	Active	2004
AX29	1		
AX32	1, 3	Active	1981
AX34			
AX97	1, 13	Active	2004

Transect	Agency	Status	Year
IX01	9, 1	Active	1987
IX02		Active	
IX06	6		
IX08	12		1992
IX09	14, 17		
IX10	14, 16, 17		
IX12	9	Active	1986
IX14	12	Active	1990
IX15	2, 4, 6	Active	1994
IX21	2, 4, 6	Active	1994
IX22	9	Active	1986
IX28	4, 2	Active	1993
IX29		Active	
IX31	2		
MX01	21, 9, 1	Active	2007
MX02	21, 9	Active	2007
MX04	21, 9, 1	Active	2007
MX05	21, 22	Active	
MX07	21, 24	Active	

Transect	Agency	Status	Year
PX02	9	Active	1983
PX04	7		
PX05	2, 16, 17, 7	Active	2009
PX06	2, 7, 1	Active	1986
PX08	2, 1	Active	2004
PX09	2, 1	Active	1987
PX10	2, 1	Active	1991
PX11	9	Active	1986
PX12	7	Active	
PX13	2, 7, 1	Active	1986
PX30	4, 2, 7	Active	1991
PX31	2, 7, 1	Active	1986
PX32	4	Active	
PX33	4	Active	
PX34	4, 2	Active	1991
PX37	2, 1	Active	1991
PX38	2	Active	1993
PX39	25	Active	
PX40	8, 17	Active	1998
PX44	2, 1	Active	1991
PX45	8, 16	Active	
PX46	16		
PX50	18, 2		1993
PX53	9		
PX81	2		1997

Agency key

1	USA-AOML
2	USA-SIO
3	USA-NMFS
4	AUS-CSIRO
5	FRA-IRD/BREST
6	ZAF-UCT
7	FRA-IRD/NOUMEA
8	JPN-TOHOKU-U
9	AUS-BOM
10	GER-BSH
11	ARG-SHN
12	IND-NIO
13	BRA-FURG
14	UK-UKMO
15	IND
16	JPN-JMA
17	JPN-JAMSTEC
18	NZL-MSNZ
19	JPN
20	UK-BAS
21	IT-ENEA
22	IT-INOGS
23	FRA-UP
24	CY–U.Cyprus
25	CAN-DFO

Table 1 - XBT transects performed by the international community during 2011, including their current status and the year in which operations on these transects started.

Approximately 22,000 XBTs are deployed every year, of which 15,000 are transmitted in real-time and ingested into operational data bases. There are approximately 40 ships participating in the XBT network. A large number of XBTs deployed by non-US agencies are the result of donations from the US (NOAA), thereby making the operation highly dependent on the continuing support of one single institution. International collaboration is key to the success to the implementation of the XBT network, where the operations are related to ship recruiting, deployment of probes, data transmission, data quality control, and archiving.

There are approximately 30 ships transmitting TSG data, most of which are operated by French institutions and by the US/NOAA research and SOOP fleet.

Web tools to monitor real-time data flow from XBTs (http://www.aoml.noaa.gov/phod/GTS/XBT/) and TSG (http://www.aoml.noaa.gov/phod/GTS/TSG/) into the GTS have been developed. Other sites, such as http://goos142.amverseas.noaa.gov/db/xbtplotapp.html permit the monitoring of SEAS transmissions into the GTS. These tools are routinely used to monitor and track the deployment of XBTs and of TSG observations.

4. GLOBAL SEA LEVEL OBSERVING SYSTEM (GLOSS)

Implementation Goal	Implement the GLOSS Core Network of about 300 tide gauges, with geocentrically-located high-accuracy gauges; ensure continuous acquisition, real-time exchange and archiving of high-frequency data
Metric now used by OCG	Number out of 300 real-time data-transmitting tide gauges in the GLOSS Core Network, as reported at the data archive

The GLOSS GE-XI in 2009 marked the 25th anniversary of the Global Sea Level Observing System (GLOSS). GLOSS has expanded beyond the original aim of providing tide gauge data for understanding the recent history of global sea level rise and for studies of interannual to multi-decadal variability. Tide gauges are now playing a greater role in regional tsunami warning systems and for operational storm surge monitoring. The GLOSS tide gauge network is also important for the ongoing calibration and validation of satellite altimeter time series, and as such is an essential observing component for assessing global sea level change.

Significant milestones for the programme are as follows:

- A Waves & Water Level workshop was held in Paris as part the GLOSS GE-XII (November 2011) to try and build stronger ties between GLOSS and surge and wave community.
- GLOSS has advocated a digitization program for data recovery of historic tide charts.
- The status of the GLOSS Core networks will be made more transparent to outside users, and this will serve as a *de facto* metric for the health of the program.
- The quality control manual for sea level data was completed for GLOSS GE XII meeting and will be published in 2012.
- IOC/GLOSS hosted the WCRP workshop “Understanding Sea Level Rise and Variability” (6-9 June 2006. The proceeding/book from that workshop was published in June 2010 and has been widely cited. A follow on workshop WCRP/IOC Workshop on Regional Sea Level Change was convened from 7 - 9 February 2011 at IOC (Report available http://www.ioc-cd.org/index.php?option=com_oe&task=viewDocumentRecord&docID=7252).
- The IOC Manual on Sea Level Measurement and Interpretation has been translated to Arabic and will be published in 2012.

An update of the GLOSS Implementation Plan has been completed. The plan will provide a blueprint for the next 5 years. Some of the aims of the plan are:

- Expand the number of continuous GPS stations co-located with sea level stations in the GLOSS Core Network
- All sea level stations in the GLOSS Core Network to report data in near real time
- Monitoring in support of water level hazards (e.g., tsunamis, storm surge)
- Improved database capabilities

The number of sea level stations reporting to the GLOSS Data Centres has increased markedly over past last ten years, particularly for stations that report in near real-time (see Figure 8). Just over 75% of the GLOSS Core Network (GCN) of 293 stations can be considered operational, and there are focused efforts to address the remaining 25% of stations not currently on-line. Since that GLOSS has adopted a common metadata standard (GLOSS Data Centers meeting, Honolulu 2010), and is in the process of implementing across all data centers. The next steps are to adopt common services for distributing the data.
The current goal is to improve data integration for the benefit of end users. Towards this end GLOSS work will include:

- Development of a single source for obtaining data from all GLOSS data suppliers.
- Development of a metadata rich format to help users to better understand the data.
- Use of netCDF "aggregation" techniques to allow users to side-step handling many files.
- Insuring that data can be used by more communities, for more purposes.
- Insuring that data will be more readily found through popular search portals.

GLOSS contributes actively in the development of tsunami warning systems in the Pacific and Indian Oceans, and in the Mediterranean and the Caribbean. Following the 2004 Indian Ocean Tsunami, more than 50 GLOSS stations in the Indian Ocean were upgraded to real time data reporting. Several Indian Ocean countries further densified their national sea level networks (India, Indonesia, Kenya, Maldives and Mauritius). GLOSS is working to develop the sea level networks in the Caribbean and North Africa. Progress is slower here due to a lack of funding.

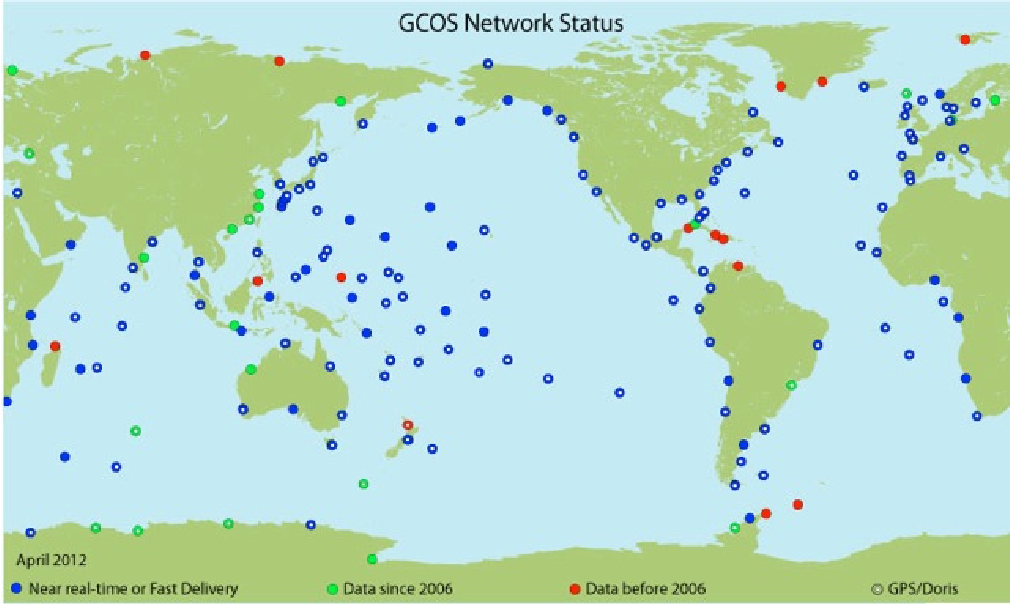


Figure 8 – Configuration of the GLOSS/GCOS Core Network. There have been important improvements in the number of tide gauges reporting high-frequency data in near real-time (typically within 1 hour), although challenges remain.

Some additional highlights of progress during the last interessessional period:

- GLOSS has participated and contributed to the report from the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG): Inter-ICG Task Team 1 on Sea Level Monitoring for Tsunami (http://unesdoc.unesco.org/images/0019/001939/193911e.pdf)
- IOC/GLOSS has organized sea level network maintenance in the Indian Ocean Tsunami Warning System through contract with University of Hawaii Sea Level Center (2009-2011).
- GLOSS has also participated in several tsunami related proposals that have had a sea level component (i.e., ESCAP proposal for Comoros, Tanzania and Mozambique). GLOSS also participates in projects under the IOC/IOCARIBE-EWS to enhance sea level networks in the Caribbean.
- India now provides real time sea level data from a number of GLOSS Core Network stations in support of tsunami monitoring.
- The IOC Sea Level Station Monitoring Facility web service has been widely used by the tsunami community. For example, during the 11 March 2011 Japan tsunami the web site received 2,901,945 web hits (about 65 times more than a normal day). High hit rates were also encountered during the 2010 Chile tsunami.

GLOSS has sought to define land motion at tide gauges through collaborations with IGS (originally the International GPS Service for Geodynamics, now the International GNSS Service) and the TIGA project (Tide Gauge Benchmark Monitoring Project). GPS and DORIS (Doppler Orbitography Integrated by Satellite) measurements at tide gauges are expected to increase in the coming years through specific initiatives and by the continued overall growth of the ITRF (International Terrestrial Reference Frame). TIGA provides an important linkage of the tide gauge and geodetic communities in this effort. Results from a status survey on co-located tide gauges and continuous GPS stations are available at http://www.sonel.org/-CGPS-TG-Survey-.html. In connection with the eleventh session of the GLOSS Group of Experts (GLOSS-GE-XI, May 2009), a Workshop on Precision Observations of Vertical Land Motion at Tide Gauges was convened. The aim of the workshop was to develop a coordinated plan for a new initiative to install and upgrade continuous GPS stations co-located with critical sea level stations in the GLOSS Core Network and Long-term Time series (LTT) networks. Detailed information is available at http://ioc-goos.org/glossgexi.

The GLOSS programme has benefited recently by the collaboration of the UNESCO/IOC and the

Flanders Marine Institute (VLIZ, Kingdom of Belgium) to develop the earlier mentioned web-based global sea level station monitoring service (see http://www.ioc-sealevelmonitoring.org). The web portal provides a view of the GLOSS and other sea level datasets received in real time from different network operators and different communication channels. The service provides information about the operational status of real time sea level stations as well as a display service for quick inspection of the raw data stream. The number of real time sea level stations that the IOC Sea Level Station Monitoring Facility tracks has grown from about 320 stations (1 Jan 2010) to 468 stations (31 Dec 2011).

The GLOSS programme continues to support training and technical advisory activities carried out with national tide gauge agencies and partner programmes including the regional tsunami warning systems.

Some activities include:

- Training organized for one Nigerian scientist at UK National Oceanography Center
- Tide gauge equipment provided for Comoros, Pakistan, Haiti, Nigeria, Mozambique, Iran.
- Technical maintenance missions were organized to Takoradi (Ghana), Nouakchott (Mauritania), Djibouti and Mozambique.
- Technical missions to Oman and Caribbean have been carried out to provide advice on network development and in preparation of installations/upgrades of national/regional sea level networks in 2012/2013.
- A one week training course was organized for hydrographers from Pakistan at the National German Research Centre for Earth Sciences (June 2010). A GLOSS Sea Level training course was also organized for Caribbean sea level station operators (January 2011).

5. OVERVIEW ACTIVITIES - ASSOCIATED PROGRAMMES

5.1 Argo profiling float programme

Implementation Goal	Sustain the global 3x3 degree network of 3000 Argo profiling floats responding to its core mission, reseeding the network with replacement floats to fill gaps, and maintain density (about 800 per year)
Metric now used by OCG	Number out of 3000 Argo floats reporting in real time, on the GTS

Argo is a global array of 3,000 free-drifting profiling floats that measures the temperature and salinity of the upper 2000 m of the ocean. This allows, for the first time, continuous monitoring of the temperature, salinity, and velocity of the upper ocean, with all data being relayed and made publicly available within hours after collection. Currently, over 3300 Argo floats are operating globally (Figure 9). Special care is being taken to rate float deployments based on various factors like float density or probability to survive (Argo Information Centre tools and services). In addition to planning where to deploy floats, it can be difficult to find ships and coordinate float deployments. The Argo TC has created a mailing list to help circulate cruise information more quickly to scientists who have floats they need to deploy (ships@jcommops.org). The Argo TC has also helped in recruiting the *Lady Amber*, a 20 m sailing vessel, which can be chartered to deploy Argo floats anywhere in the world ocean excluding high piracy zones. The *Lady Amber* has already completed several successful cruise across the Indian Ocean to deploy floats, and is planning additional cruises, perhaps with other platforms also being deployed.

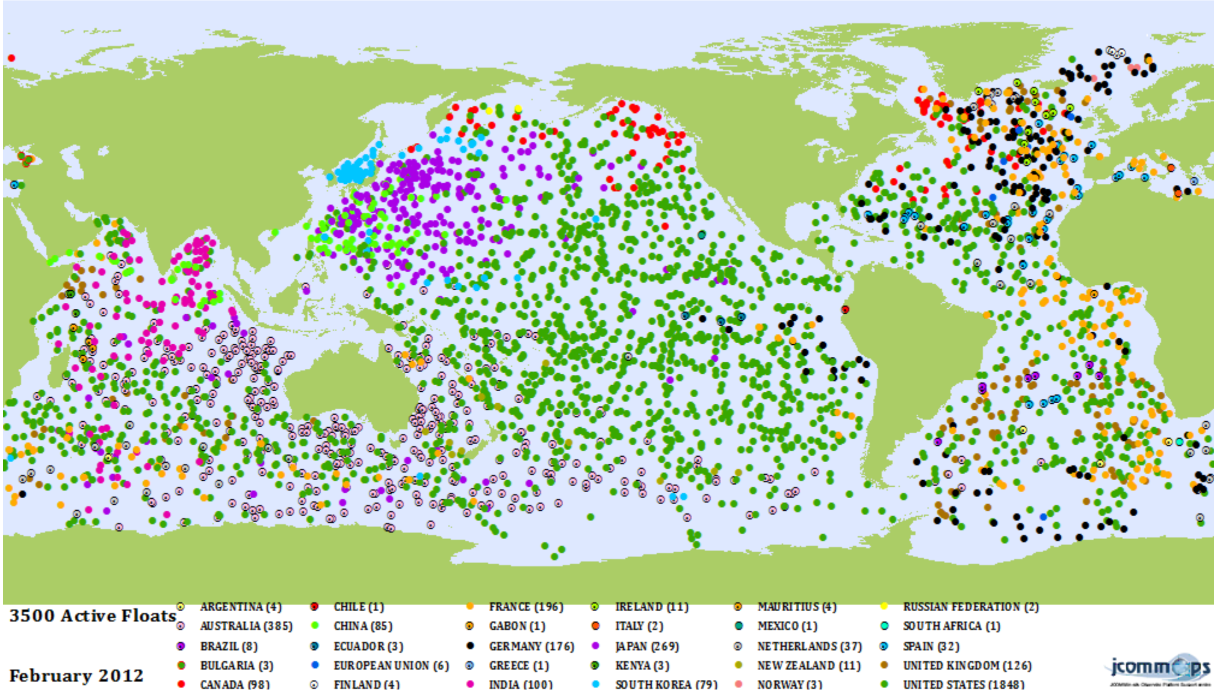


Figure 9 - Twelve nations maintain the global array and twenty more fill regional gaps

Almost 90% of Argo profile data are available to users within 24 hours of a profile being made. In the past year, work was done at the GDACs to reduce delays for data from some of the DACs. The real-time data are subject to similar integrity and quality checks as the real-time XBT data stream. However, some salinity sensors drift with time due to biological fouling and physical deformation. The backlog of data needing these delayed mode corrections has been reduced. Currently, 79% of floats needing to be put through the delayed mode quality control process have been completed. This number is up from last year's 63% and is getting close to being up to date. More work still needs to be done to try and reduce the small backlog of floats left. Many of the floats left are difficult as they are either older and thus lacking detailed information about sensors, or are deployed by countries into areas of the ocean where the scientists do not have as much expertise, making it difficult to quality control the floats. These issues are being addressed by the Argo Data Management Team. As it is important to carefully review files in a timely manner, an additional quality control check that compares sea level anomalies from satellite altimetry to dynamic height anomalies from Argo floats is done by S. Guinehut four times a year. This additional quality control check helps scientists identify potential problematic floats even before delayed mode quality control can be done. Other such methods are under development to help detect large scale problems with the float data.

Float technology is an important part of the Argo array and there have been significant developments over the past year to float technology. In 2010, 18% of floats deployed were equipped with Iridium communications. It is expected that this number will continue to grow as more floats switch over to Iridium or other high bandwidth communication systems. Iridium allows for more data to be sent in less time. Both the SOLO and the PROVOR have new generation floats available. The SOLO-II is smaller, more efficient and uses Iridium communications. About 60 SOLO-II floats are expected to be deployed this year. ARVOR floats are also smaller and more efficient than their PROVOR predecesser, but come with ARGOS communications. Currently both Iridium and Argos-3 outfitted ARVOR floats are under development. Additionally, the Deep NINJA float is being developed to profile to at least 3000m. Besides deep profiling, new sensors are being piloted on Argo floats.

Following direction from OceanObs'09, Argo is exploring how to expand to new sensor types and to new areas of float coverage, both on the surface and below. With the addition of two-way communications, Argo is also analyzing changing sampling schemes after deployment. Several individuals or groups within or associated with Argo have agreed to explore various options including expanding to the seasonal ice-zone, changing the near surface temperature sampling scheme, making floats capable of a deeper range, and establishing a more uniform method of sampling for Iridium floats. Even with the increased number of delayed mode profiles available, Argo still continues to focus on improving the quality and timeliness of both real-time and delayed-mode data. Analysis continues to be done on the effects of the pressure bias within Argo with the goal of recovering as much data as possible.

Demonstrating the value of Argo data remains a high priority of the Argo program. With a global array in place since 2004, researchers are able to use Argo data to investigate global and regional phenomena, with over 100 papers published using Argo data in 2011 already. The broad range of research topics includes water mass properties and formation, air-sea interaction, ocean circulation, mesoscale eddies, ocean dynamics, and intra-seasonal to multi-decadal variability. Secondly, Argo is the core subsurface dataset for ocean data assimilation modeling, used by modeling centers around the world in ocean reanalyses and for initializing seasonal-to-decadal prediction. (See http://www-argo.ucsd.edu for links to all operational centers known to be using Argo data). Already, operational centers including NCEP, ECMWF, and the U.K. Met Office are reporting improvement in their products due to the impact of Argo data. Additionally, Argo recently developed a Google Ocean layer which includes data for each float, stories on a smaller subset of floats, an animation showing the cycle of an Argo float and property plots overlaid onto the globe showing various properties from Argo data. The use of Argo in secondary and tertiary education is growing rapidly, as students anywhere in the world can now explore the global oceans from their desktop.

5.2 OCEAN Sustained Interdisciplinary Timeseries Environment Observation System (OceanSITES)

Implementation Goal	Complete and maintain a globally-distributed network of 30-40 surface moorings as part of the OceanSITES Reference Mooring Network
Metric now used by OCG	Number of platforms reporting in the year in the NDBC or Coriolis OceanSITES GDAC [baseline requires further definition].

OceanSITES is the research-driven international project working towards the coordination and implementation of a global system of sustained multi-disciplinary timeseries observatories. Operational applications of such data include detection of events, initialization and validation of assimilation products, delivery of constraints or reference data for forecasts (especially biogeochemical and ecosystem relevant ones). In addition, there are a variety of technical applications, such as calibration and validation of data and products from other observing system elements.

The focus of OceanSITES is on sustained, Eulerian time series with high temporal resolution was reaffirmed by the group. Long-term goals remain to secure sustained support, upgrade existing stations to multidisciplinary sampling, install new stations in key unsampled regions, and make the data rapidly available to the scientific community and the public. OceanSITES will begin to develop metrics for the completion and effectiveness of the network, working with diverse groups that use the data, such as the operational weather forecasting and modeling centers and the IPCC teams.

To demonstrate the value of OceanSITES, each site will develop key products, with attention to potentially key or iconic results. The Scientific Steering Team will then look for the next level of products; those that draw from more than one site and demonstrate the additional impact of the array. OceanSITES will also seek to facilitate addition of new sensors and defining best practices that can be shared across existing and potential new site operators.

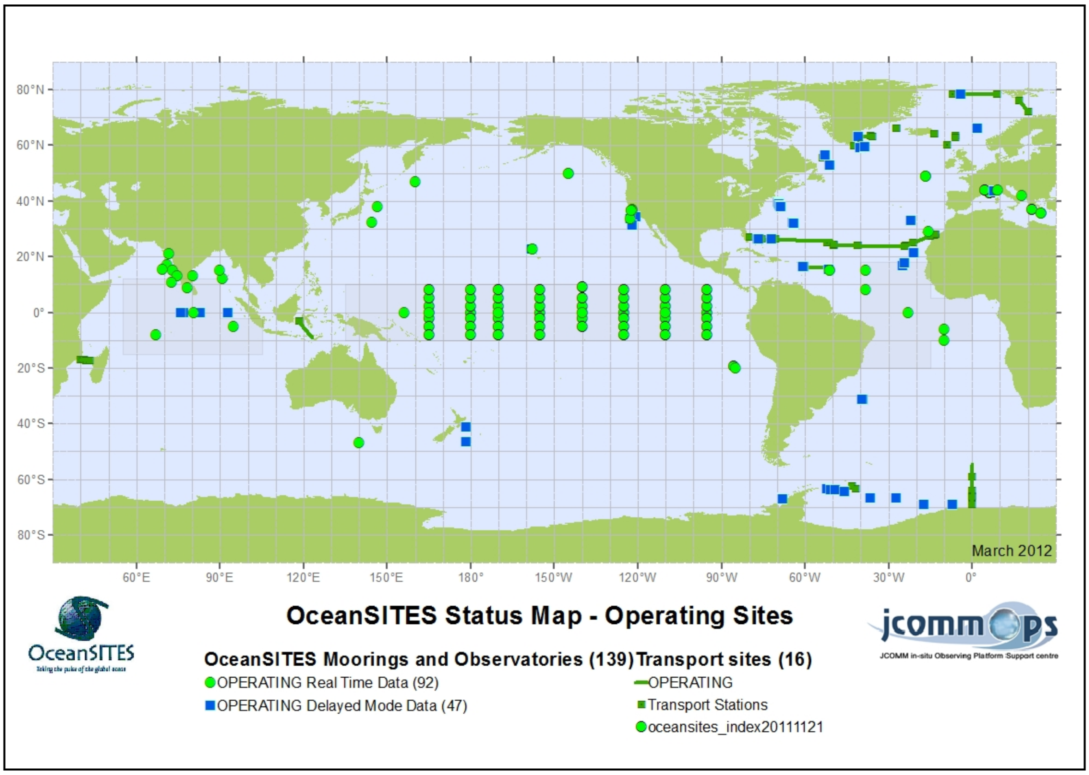


Figure 10 - The present status of OceanSITES summarized in this new map, with an updated table of OceanSITES located http://www.oceansites.org/network/index.html.

OceanSITES has set two near-term objectives. First, it advocates the establishment of a core, backbone network with homogeneous, multidisciplinary instrumentation (see Figure X). Second, in response to a need identified at OOPC Deep Ocean Observing Strategy Workshop (Paris March 2011), OceanSITES is moving to deploy deep (deeper than 2,000 metre) temperature/salinity recorders at as many sites as possible.

The OceanSITES data system uses a common NetCDF Data Format, and provides (http://www.oceansites.org/data/index.html) a user manual, a sample data set, and cdl file to the community. OceanSITES operators are provided assistance if needed and a format tester to facilitate preparation in the NetCDF formatted data. Each operator is aligned with or serves as a DAC (Data Assembly Center) to see that the data is formatted correctly; IFREMER Corilois and NDBC serve as mirrored GDACs (Global Data Assembly Centers) to collect data from the DACS and serve data to users. The OceanSITES Data Team works to identify the correct CDF variables names and metadata, and as the sites increasingly carry more multidisciplinary sensors, the effort is expanding the CDF variable name lexicon to be used with time series stations.

As a basically volunteer aggregation of observatory operators, OceanSITES has embarked on improving documentation and sharing of best practices. Further, OceanSITES is discussing the best way forward for new sensors to be deployed across the array, especially in the case where a given operator may lack expertise in that sensor. OceanSITES is considering a mentoring program, where best practices and capacity building for special sensor types would be provided by the experienced users to new users. This could be expanded to other areas of sustained time series technologies.

Moving forward OceanSITES will focus on a number of issues: i) demonstrating the value of sustained time series and of a coordinated network of sustained time series stations; ii) continuing the success of the collection and free and open distribution of data thus far achieved by OceanSITES with the support of IFREMER Coriolis (France) and NDBC (USA) ; iii) developing a subset of the OceanSITES equipped with deep temperature/salinity sensors to answer the need for that data from depths greater than 2,000 metres; iv) developing a backbone subset of OceanSITES with common multidisciplinary sensors; and v) pressing for documentation and sharing of best practices for observatory operators, over topics ranging from data formats and metadata to instrument calibration and deployment. OceanSITES will be working on improved website material, asking each operator to provide select high impact results.

5.3 International Ocean Carbon Coordination Project (IOCCP) and the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP)

Implementation Goal	• Implement a systematic global full-depth water column sampling through repeat hydrography for ocean physical and carbon variables in a decadal survey • Implement and sustain a global network of surface carbon flux observations (through VOS and research ships) and carbon time series stations (see also OceanSITES)
Metric now used by OCG	• Number of repeat hydrographic sections in the decadal survey submitted to data archive [baseline requires further definition: proposed rolling index of ship days secured to maintain repeat hydrography lines] • No metric has been set for surface carbon flux or carbon timeseries observations

The IOCCP promotes the development of a global network of ocean carbon observations for research through technical coordination and communications services, international agreements on standards and methods, and advocacy and links to the global observing systems. The IOCCP is co-sponsored by IOC and the Scientific Committee on Oceanic Research (SCOR).

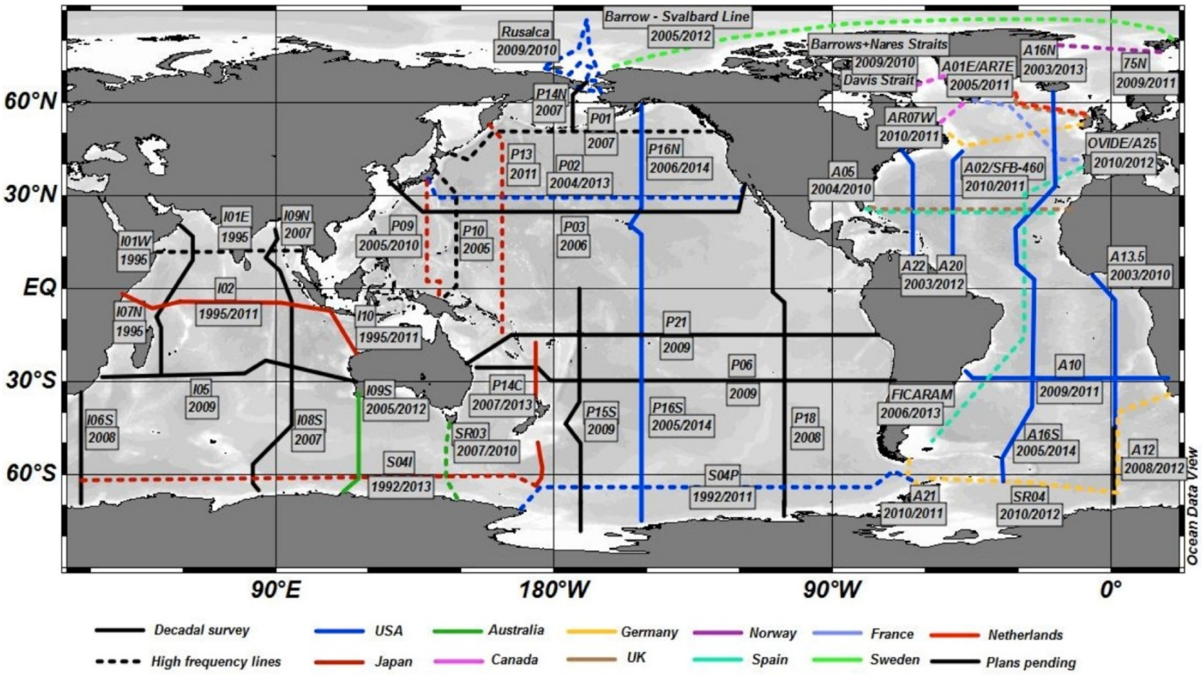


Figure 11 - The status and plans of repeat hydrographic sections coordinated by IOCCP and GO-SHIP in late 2011.

The IOCCP continues to coordinate a highly diverse set of activities to facilitate the development of globally acceptable strategies, methodologies, practices and standards, homogenizing efforts of the research community and scientific advisory groups as well as integrating ocean carbon programs and activities into globally integrated Earth system observing networks. Coordination and communication activities of IOCCP relate to hydrographic survey cruises, development of a global network of surface ocean carbon observations and time-series observations. IOCCP is also actively involved in helping to develop international agreements on standards and methods, such as the recently completed GO-SHIP: Repeat Hydrography Manual and the Guide to Best Practices for Ocean CO_2 Measurements, and facilitates data collection, management and data synthesis activities.

A more efficient and better coordinated network of surface ocean carbon observation platforms including voluntary observing ships and research ships remains one of the key objectives for IOCCP. To achieve a sustained, scientifically robust and cost efficient ocean carbon observing system, stronger implementation ties with other global observation programs, such as GOOS, GCOS, DBCP and Argo, will be developed. In addition, the IOCCP will continue collaboration with the World Ocean Council, a high-profile advocacy group aiming at improving ocean understanding through the involvement of ocean user industries (e.g., shipping, oil and gas, fisheries, tourism) in ocean observations. The IOCCP will take an active role in designing the Industry - Global Ocean Observing and Data System (I-GOODS). This system, based on experience of IOCCP and other global ocean observing networks, would be designed to incorporate opportunities from various industries into scientific efforts and would allow synergies between ocean users' industries, technology industry and key national, regional and global ocean observing coordinators.

There is growing momentum around the concept of “Blue Carbon” as a key component of climate change mitigation options. Blue Carbon is a new concept describing the carbon storage and sequestration potential of coastal (‘blue’) ecosystems, namely, mangroves, sea grasses, and salt marshes, although other coastal and marine ecosystems might also be of interest. Clear demonstration of the carbon storage and sequestration services provided by coastal ecosystems may transform the effectiveness of conservation, management, and restoration of coastal ecosystems. A fundamental barrier to this is a global lack of consistent, reliable, and interoperable spatial datasets of ecosystem extent, and carbon stock and flux, that are available at the required spatial and temporal resolutions and readily accessible by a range of communities around the globe. Blue carbon ecosystems constitute an interface between the ocean and the land, an area often disregarded by both marine and terrestrial carbon communities. The IOCCP with its extensive experience in facilitating data collection, management and data product development is well placed to support evolving efforts, to generate the technologies, networks, and partnerships required to increase the availability of key coastal carbon data.

Following the public release of Surface Ocean CO_2 Atlas (SOCAT) version 1.5 in 2011, SOCAT 2 has a tentative release in late 2012. Several technical and practical aspects of the second release such as streamlining data submission procedures to incorporate agreed formats and automation of data quality control procedures will be coordinated over the next 12 months. The IOCCP is responsible for drafting the SOCAT Implementation Strategy to ensure a stable project development in the short to mid-term (3 to 5 years). Possibilities to fund a technical position focused on SOCAT issues will be investigated and will become an integral part of the SOCAT Implementation Strategy.

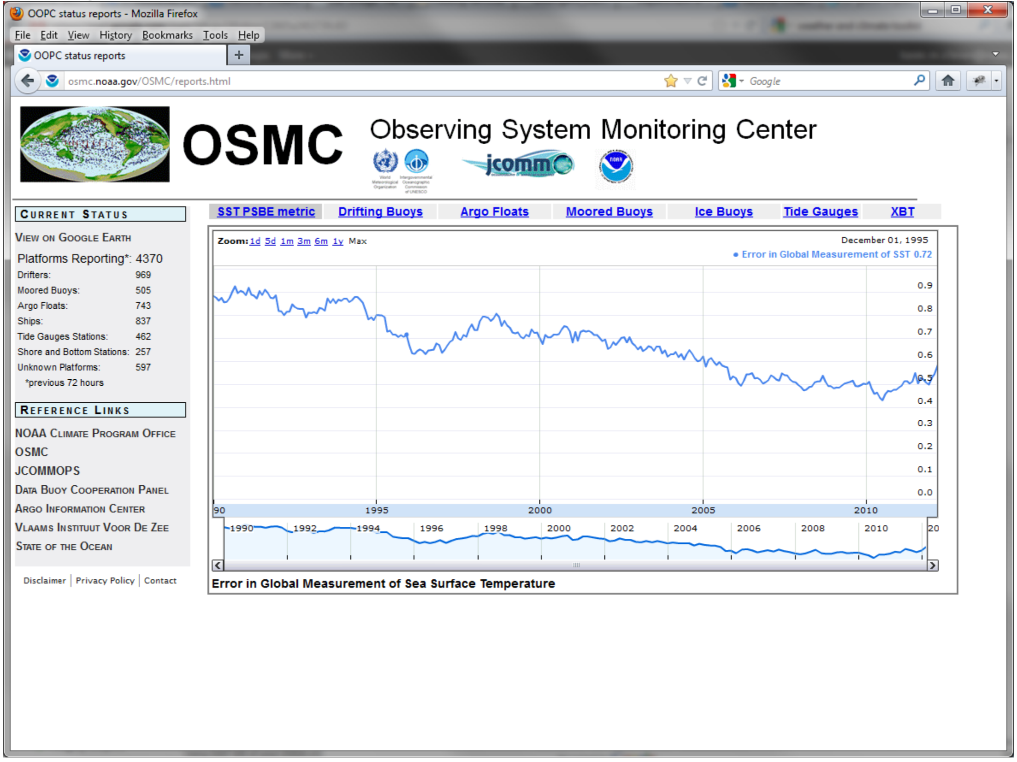
The IOCCP will continue to serve as a resource for the ocean carbon hydrography through collaboration with the Carbon Dioxide Analysis Center (CDIAC) at the US Oak Ridge National Laboratory. Resources provided will include information on cruise plans, continuously updated cruise maps and reference section tables including measurement being made at each location.

The IOCCP will further develop its relationship with OceanSITES and the ocean carbon and biogeochemistry community to better understand the needs of the community and support improved coordination of time-series observations. One of the primary activities will be for IOCCP and OceanSITES to develop a guide to best practices and instrument user guide for carbon data and to develop consistent terminology based on SeaDataNet vocabulary. The overarching objective is to incorporate carbon and biogeochemical data into OceanSITES.

Ocean acidification is an emerging issue that requires more research and monitoring efforts. The 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) concluded that ocean acidification has the potential for major impacts in coastal areas. Wind-driven, seasonal upwelling of subsurface waters in coastal margins brings CO_2-enriched waters onto the shelf and, in some instances, into the surface ocean. This water contains a high level of CO_2 resulting from natural respiration processes in the subsurface layers and is also significantly contaminated with anthropogenic CO_2. Some of the world’s most productive fisheries are located within coastal zones. As a result impacts on marine food webs caused by ocean acidification could be more severe than previously anticipated. The IOCCP plans to organize (with a set of international partners) a workshop focused on increasing observations of the carbonate system in coastal waters to better monitor its seasonal and interannual variability in order to mitigate ocean acidification impacts on coastal ecosystems.

6. PERFORMANCE METRICS

Observing System Status reports are developed and used to monitor progress and evaluate the effectiveness of the system for observing ECVs (see Figure 12). A major goal of the OCG workplan for the next intersessional period will be to work with the Ocean Observation Panel for Climate (OOPC) on metrics for ECVs.



Platforms Reporting*: 4370

Drifters:	969
Moored Buoys:	505
Argo Floats:	743
Ships:	837
Tide Gauges Stations:	462
Shore and Bottom Stations:	257
Unknown Platforms:	597

*previous 72 hours

December 01, 1995

• Error in Global Measurement of SST 0.72

Error in Global Measurement of Sea Surface Temperature

Figure 12 – The SST metric reports error in global sea surface temperature

7. OPA INTERACTIONS WITH OTHER OBSERVING COMMUNITIES

7.1 Interactions with the Satellite observing community: the DBCP-GHRSST pilot project

Over the last few years the DBCP has turned some of its attention to a number of pilot projects, with the aim of evaluating new technologies that might in due course transition to operational use. It has also tried to strengthen its links with other observing system groups, from both the *in situ* and remote sensing communities. In the particular case of the satellite SST community, the DBCP has engaged with the Group for High Resolution SST (GHRSST) to fully understand the needs for high resolution *in situ* SST, on which the community depends for its satellite SST retrieval validations, and has worked with GHRSST in helping to equip the future drifting buoy fleet with sensors that meet its requirements. Initial practical steps have been taken by Météo France over the past 24 months within the context of the DBCP-GHRSST Pilot Project to equip a fleet of drifters with HRSST-1 sensors. These now routinely report on the GTS in near real time. More recently, the UK Met Office has taken delivery of a number of HRSST-2 drifters, partially funded by the DBCP. These incorporate a more advanced HRSST sensor module, and are due to be deployed in the tropical north Atlantic in the first half of 2012. The joint pilot project will come to an end in 18 months, and moves will soon have to be made to evaluate its success or otherwise, and to develop proposals for follow-on activities if deemed worthwhile. In this context, early involvement with the calibration/validation team for the ESA Sentinel-3 satellites, the first of which is due to be launched in 2014, has highlighted the synergies that will flow from much stronger collaboration between the two communities

7.2 Interactions with the International Telecommunication Union and the submarine cable community

Guided by recent resolutions from its governing body, the International Telecommunication Union (ITU) convened a workshop (Rome, September 2011) to draw together intergovernmental bodies, scientists and cable operators to investigate the potential of submarine telecommunication cables for climate monitoring and disaster warning. JCOMM interests were promoted by delegates from both the IOC and WMO. In particular, the high potential value of future cables in supplementing the existing vandal-prone tsunameter network was well appreciated, alongside the possibility of using cables to monitor temperature changes in the deep ocean. A task team is being established under joint ITU-IOC-WMO sponsorship to progress towards a pilot project

8. TECHNICAL COORDINATION AND MONITORING (JCOMMOPS)

The JCOMM in situ Observing Programme Support Centre (JCOMMOPS) provides technical coordination across the OPA observing networks, following the direction of the DBCP, SOT, Argo Steering Team, and the OceanSITES program (see http://jcommops.org). The third session of JCOMM reinforced the role of JCOMMOPS in to promote an integrated framework for deployment and further development of ocean observing networks. Specifically, JCOMMOPS shall:

(a) Act as a focal point for implementation and coordination of observing programmes by clarifying and assisting in resolving technical issues between platform operators, data centres, manufacturers and satellite data telecommunication providers;

(b) Assist in demonstrating the scientific value of global ocean observing programmes in support of WMO and UNESCO/IOC Programmes and co-sponsored Programmes by compiling materials and assisting ocean observation science teams as appropriate;

(c) Maintain information on relevant observational requirements in support of the Global Ocean Observing System, the Global Climate Observing System and the World Weather Watch as provided by the appropriate international scientific panels, JCOMM experts participating in the Commission for Basic Systems Expert Team on Satellite Utilization and Products, and other JCOMM Expert Teams and groups;

(d) Routinely collect and distribute information on: (i) the performance of the observing system networks relative to requirements, in cooperation with the Observing System Monitoring Centre; (ii) instrumentation and telecommunication systems; and (iii) functional status and data quality of individual observing platforms;

(e) Act as a focal point for instrument and data management standardization by collecting and distributing information on current and best practices from across all elements of the observing system and by representing the observing system interest in international standardization processes;

(f) Facilitate free and unrestricted data and metadata exchange in real time, by providing appropriate technical assistance to platform operators, and serving as a collection and distribution point for select platform/instrument metadata and as a source of information on other metadata and data distribution services;

(g) Facilitate the flow of data and metadata to the archiving centres;

(h) Provide a gateway for information on observing platform deployment plans and servicing opportunities, and on operator contact information, to maximize deployment opportunities and sharing of resources;

(i) Encourage cooperation between communities, observing programmes and Members/ Member States to develop synergies between and to promote the observing systems.

JCOMMOPS has been successful in providing rigorous monitoring of the networks; improving day to day assistance; providing a key focal point to oceanographers and marine meteorologists worldwide; and encouraging cooperation with developing countries (e.g., through platform donor programmes and training workshops). JCOMMOPS is funded through national contributions from Members/Member States; however JCOMMOPS requires a more stable financial base to strengthen the integration of the observing system. The Observing Panels supporting JCOMMOPS will keep seeking new and broadened contributions to sustain the existing level of support. In addition, the ability of JCOMMOPS to extend technical coordination to support other observing networks, such as gliders, is possible only with increased financial resources. The OCG will continue to work in concert with the individual panels, and to provide overall guidance of the JCOMMOPS workplan and budget.

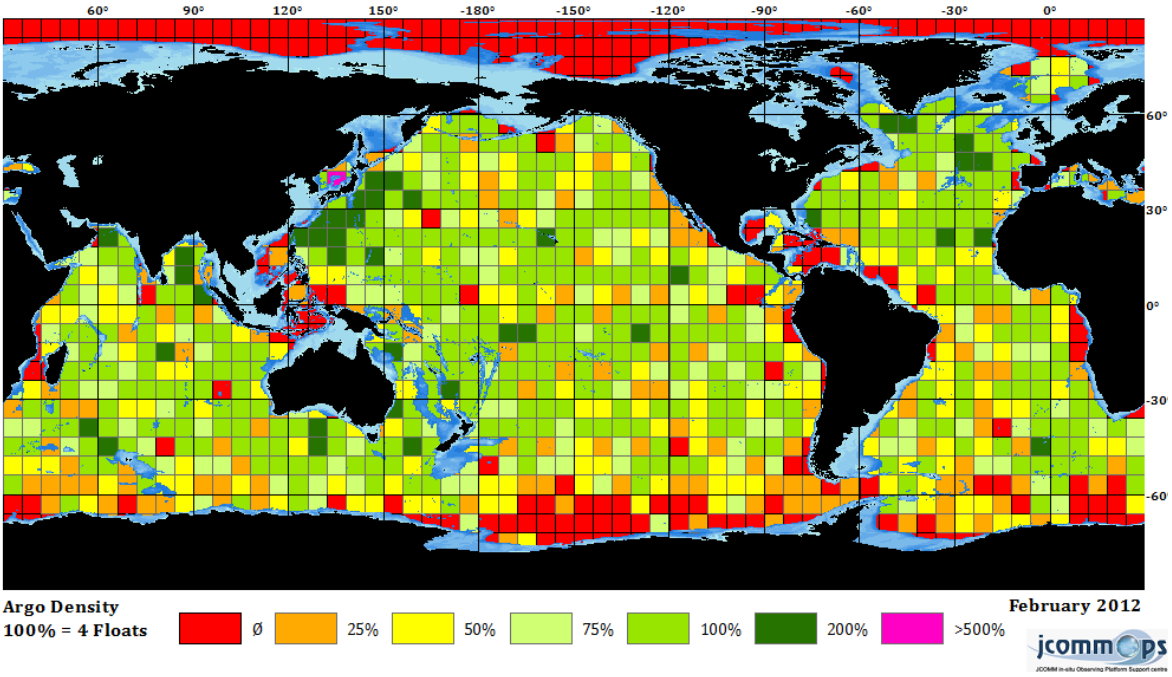


Figure 13 – Argo Network Density on a 6°x6° grid normalized on the 3°x3° Argo standard (100% means here 4 floats operating in a box).

JCOMMOPS and the OCG have developed standard base maps showing required global coverage against what is presently in place to evaluate observing system status and effectiveness; and to develop summary reports illustrating how advancements toward global coverage improve the adequacy of the observation information (see Figure 13).

JCOMMOPS and OCG have identified resources to support a two-year pilot project for a “Ship Logistics Coordinator” to be the international focal point for ship logistics for the implementation of global observing networks. All the observing programmes would benefit from this technical coordination, and Members/Members States are urged to support this effort.

JCOMMOPS has already reported success in this area with its innovative work with the South African education sailing ship, *Lady Amber*, to deploy Argo floats in parts of the Southern Indian Ocean in areas otherwise seldom visited by research or cargo vessels (Figure 14). The *Lady Amber* has operated for one year in the Indian Ocean with direct support from Argo Australia and under IOC and JCOMM sponsorship. A similar capacity is available in the Atlantic Ocean (France to West Africa) via a partnership established with “Voile Sans Frontières”. The Commission charged the OCG and JCOMMOPS to pursue this innovative approach to deployment challenges, especially in ship-sparse areas, and noted the operational, educational and promotional opportunities.

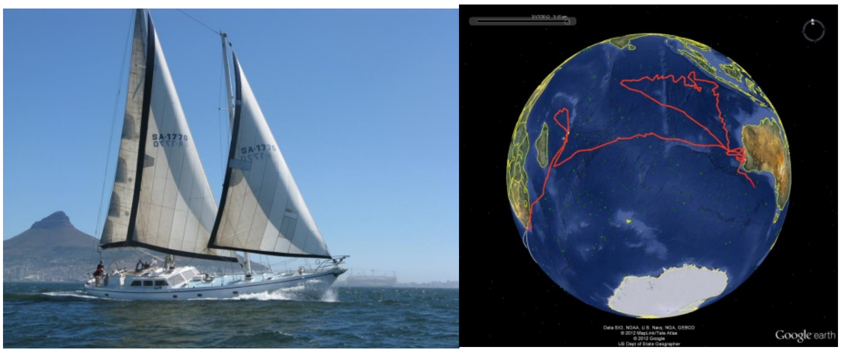
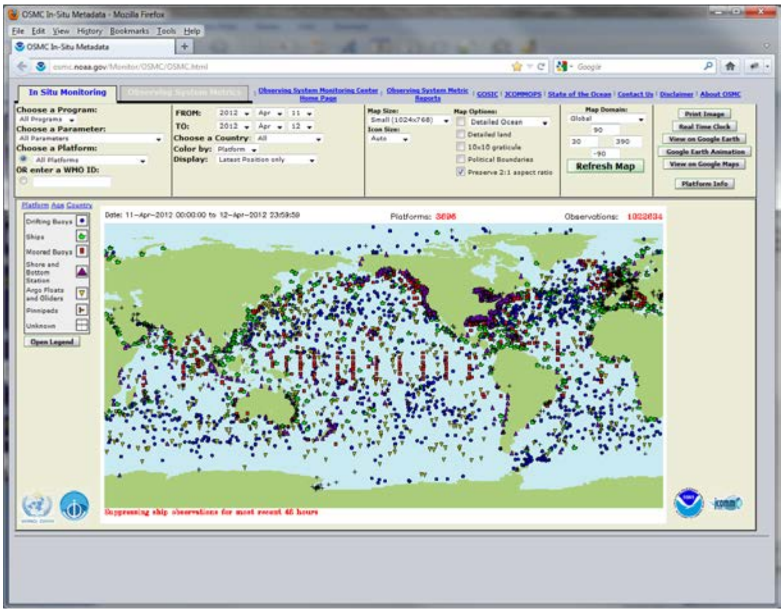


Figure 14 – JCOMMOPS innovation has successfully enlisted the Lady Amber to deploy Argo floats in parts of the Southern Indian Ocean in areas otherwise seldom visited by research or cargo vessels.



Choose a Program: All Programs

Choose a Parameter: All Parameters

Choose a Platform: ● All Platforms

OR enter a WMO ID: ○

FROM: 2012 Apr 11

TO: 2012 Apr 12

Choose a Country: All

Color by: Platform

Display: Latest Position only

Map Size: Small (1024x768)

Icon Size: Auto

Map Options: ☐ Detailed Ocean

☐ Detailed land

☐ 10x10 graticule

☐ Political Boundaries

☑ Preserve 2:1 aspect ratio

Map Domain: Global

90

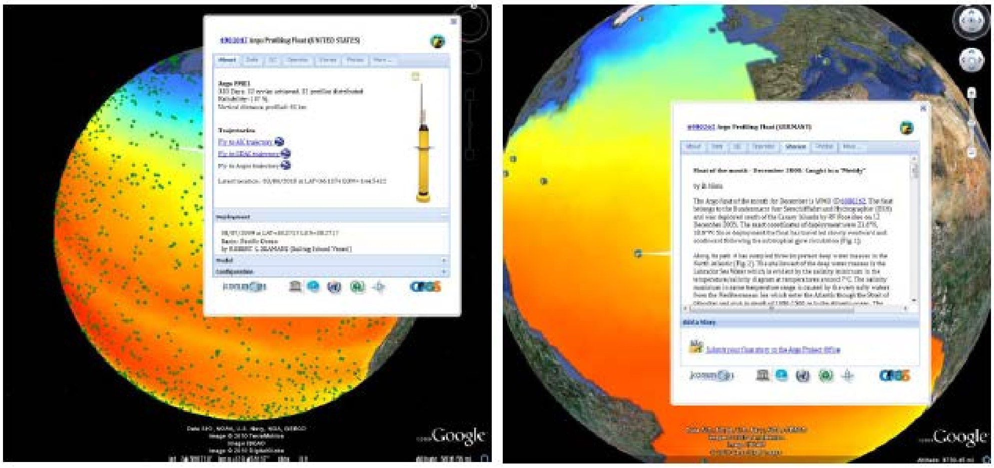
30 390

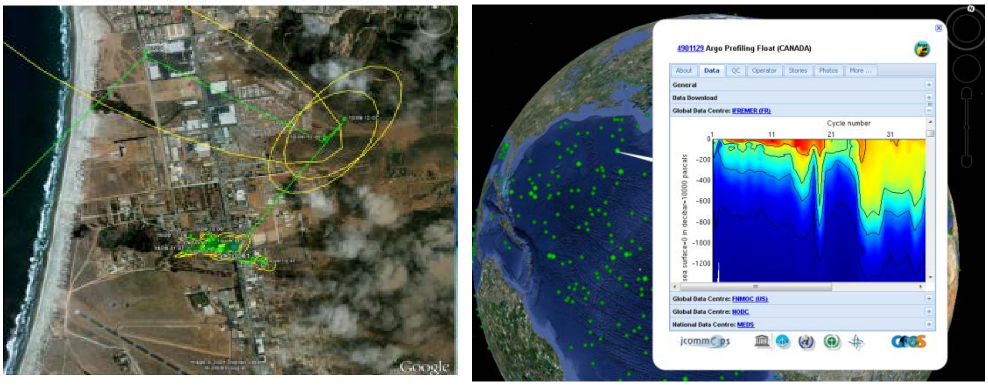
-90

Date: 11-Apr-2012 00:00:00 to 12-Apr-2012 23:59:59 Platforms: 3696 Observations: 1022634

Suppressing ship observations for most recent 48 hours

Figure 15 – The OSMC allows users to monitor observing system status in near-real-time (the database is updated daily) and sort platform reports by country, variable, time frame and platform type.





Figures 16: http://argo.jcommops.org/argo.kml - a new Google Earth toolbox for Argo has been developed by the Argo Information Centre.

JCOMMOPS cooperates closely with the Observing System Monitoring Centre (OSMC – see http://osmc.info) to develop near-real-time monitoring tools for use by observing system managers. Both of these centres access different data streams for monitoring (GTS and Global Data Centres) so can compare and check for discrepancies and synchronize their metadata. While JCOMMOPS maintains each individual platform metadata and provides the status of each network, the OSMC focuses on reporting the state of the ocean by demonstrating how the requirements are met in terms of variables and timeframes across all *in situ* ocean observing systems (see Figures 15 and 16).

Members/Member States are urged to strengthen their support for the JCOMMOPS, which has demonstrated its value to the technical coordination and integrated implementation of the ocean observing networks it supports.

8. INTERSESSIONAL MEETINGS INVOLVING THE OPA

2010 March	OceanSITES DMT	Paris, France
April	RMIC-(RA-IV)-I	Stennis, USA
June	GHRSST-XI	Lima, Peru
September	IFSOO-TT-2	Paris, France
October	DBCP-XXVI	Oban, Scotland
	JTA-XXX	Oban, Scotland
November	MAN-VIII	Paris, France
December	PMO-IV	Orlando, USA
2011 March	AST-XII	Buenos Aires, Argentina
April	SOT-VI	Hobart, Australia
	OCG-IV	Hobart, Australia
May	DBCP-WIO-II CB workshop	Balaclava, Mauritius
June	GHRSST-XII	Edinburgh, Scotland
July	RMIC-II	Tianjin, China
September	ITU cables-for-climate workshop	Rome, Italy
	MAN-IX	Geneva, Switzerland
	DBCP-XXVII	Geneva, Switzerland
October	JTA-XXXI	Geneva, Switzerland
November	GLOSS Group of Experts XII	Paris, France
	OceanSITES 2011	La Jolla, USA
December	WOC workshop	Paris, France
	JCOMMOPS-I	Toulouse, France
2012 March	GHRSST workshop	Melbourne, Australia
	Sentinel-3 cal/val workshop	Frascati, Italy
April	DBCP-WIO-III CB workshop	Mombasa, Kenya
	Preparatory workshop for a satellite communications forum (SATCOM-I)	Toulouse, France

APPENDIX D

Future tasks for the JCOMM OCG

Draft by D Legler and D Meldrum, Sept 2014

1. Develop better ways of routinely expressing the state of the observing network (possibly using the SWOT framework), including by platform type and by EOV.

2. Horizon scan for platforms, sensors, technologies and methodologies that will in due course become part of the composite observing system, and seek to establish pilot activities to help evaluate and transition them to the sustained observations arena when ready.

3. Continue to participate in new initiatives to expand ocean observing capabilities, such as the joint ITU/WMO/IOC initiative to use sub-sea comms cables for ocean observation and tsunami warning, and the increased activity in coastal regions.

4. Encourage JCOMMOPS to continue its outreach to new platform groups, such as the glider community.

5. Seek to assure the growth and continuity of the JCOMMOPS service, and its relationship with the NOAA OSMC.

6. Promote the adoption of consistent standards and practices for data management amongst the observing networks to facilitate discoverability and accessibility of integrated data for the research, forecast, and end-user communities as well as for product development. [make full use of Keeley report]

7. Promote the creation and timely updating of JCOMM best practice documentation.

8. Strengthen links with the satellite community, especially in the field of in situ validation of EOVs/ECVs and for integrated product development.

9. Continue to guide WMO through the mindset change that will allow them to be comfortable with data submitted by 3rd party organizations, and will allow such organizations to have access to the WIS/GTS for verification purposes.

10. Engage with other ocean and cryosphere observation groups (e.g. GOOS, OOPC, POGO, SCOR, SCAR, SOOS, …) to develop a consistent and seamless road map for ocean (including polar ocean/sea-ice) observations.