***OOPC-12 Report***

DRAFT

2-5 May 2007
IOC/UNESCO, Paris, France

# 1 OPENING

## 1.1 Opening and Welcome

The Chair of the OOPC, Ed Harrison, opened the session at 9:00 on Wednesday 2 May 2007. He welcomed the participants, noting the number of guests from outside the domain of physical oceanography.

Harrison reminded the Panel of their terms of reference, which he paraphrased as:

- Developing recommendations for a sustained global ocean observing system, in support of WCRP, GOOS, and GCOS climate objectives, including phased implementation,
- Helping to develop a process for ongoing evaluation and evolution of the system and recommendations,
- Supporting global ocean observing activities by involved parties, through liaison and advocacy for the agreed observing plans.

The goals of the system are to provide data and information products to serve climate forecasting, assessment, and research. The system is also providing most of the data for global operational oceanography. The plan for the observing system is written with differing national priorities in mind, as well as the priorities of the ocean research community.

Harrison noted that the panel had up to now had focused on physical variables, with a link to ocean carbon through the IOCCP, since these were the ones that had the combination of mature observing technology for sustained observations as well as willing funders which made it possible to build a community consensus on moving forward with globally sustained observations. As new opportunities emerged from growing scientific questions and evolving observing technologies, the Panel was pleased to try to bring new communities into its work.

## 1.2 Review and Adoption of the Agenda and OOPC-11 report

The Chair introduced the provisional agenda, which was approved (see Appendix I). The OOPC-11 draft report was approved as final. The agenda, background documents, and all of the presentations given during the meeting are available on the meeting website: ioc.unesco.org/oopc/oopc-12.

## 1.3 OOPC activities 2006-2007 and Meeting Goals

The Chair then gave a report on Panel activities in 2006 and 2007, since its last meeting. In GCOS these included working on a supplementary report to the Implementation Plan on satellite requirements, which was submitted to the UNFCCC and garnered a response from CEOS. The Panel worked on joint projects with GCOS's Atmospheric Observations Panel for Climate (AOPC), and reported on progress to the GCOS Steering Committee. With WCRP it worked with the WCRP Observation and Assimilation Panel (WOAP), with GSOP on ocean reanalysis

metrics, and on the PIRATA review. With GOOS it worked on the coastal task team, participated in the Third GRA forum, and reported to the scientific steering committe (GSSC). The Panel had a close relationship with JCOMM, working with the Management Committee, with the Observations Programme Area Coordination Group, and with the Service Programme Area Coordination group. The panel also worked with SCOR on overall ocean research programme coordination, and for the IGOS partners in developing a review of the ocean theme.

Harrison then outlined the goals of the meeting:

- To note and consider the state of implementation of the ocean observing system (OOS), of suggested updates to the initial OOS plan, and of ongoing activities;
- to note and consider Arctic and Antarctic activities and plans, including the IPY;
- to advance linkages with basin scale ecosystem and biogeochemistry programs;
- to consider suggestions for workshops and meetings; and
- to work with GODAE in outlining future international research coordination activities in ocean forecasting.

Harrison then noted that there were a large number of upcoming meetings for which OOPC input could be valuable, and that the Panel should discuss how they could be best used to advance sustained ocean observations.

### 1.4 Overview of observing system status (JCOMM Observations Programme Area Coordinator)

Harrison gave a report on behalf of Mike Johnson, JCOMM Observations Programme Area Coordinator. The goals of the JCOMM Observations Programme Area (OPA) were to implement as much as possible of the GCOS Implementation Plan, through its own programmes and through liaison with other coordinating groups. The OPA had made important progress in standardized monitoring of the observing system implementation and data flows. Highlights in forward progress in implementation were the surface drifter observing network and Argo, both of which had advanced far towards (and for surface drifters, achieved) their targets. The OPA was working on developing improved performance metrics for the observing system. The OPA had also developed requirements for an expanded Observing Platform Support Center (OPSC) based on an expanded JCOMMOPS (see Section 7.8) which would be taken up by JCOMM. Johnson outlined the needs of a number of the observing networks, details of which can be found in his report.

The Panel **encouraged** the development of metrics of performance of the observing system that were variable-based, rather than observing network-based.

## 2 SCIENCE FOCUS

### 2.1 State of the Ocean 2006-2007

Albert Fischer presented a report that reviewed the state of the ocean and its impacts in the past year, as well as presenting the OOPC State of the Ocean website and planned improvements. Thus far the site had been aimed at a community largely in the know, that is the ocean observations community. The number of visitors to the site had increased to about 600/monthly, with exposure with links from the IOC, GOOS, CLIVAR, and JAMSTEC websites. The search engine google provided 30% of the incoming traffic. Fischer wished to improve the information about the impacts

associated with the index, the patterns of climate variability, links between indices, changes in rainfall, and even historical examples, all with references. More subsurface indices, with improved uncertainty estimates were needed, as were sea level indices. Composite indices, for example a hurricane index that was a combination of ocean heat content and atmospheric conditions would be interesting to explore. Further gaps included sea ice and the polar oceans. While the site already contained information about the observing networks contributing to the indices, a better link to the calculation of the index could be made. This would have to be done, however, while retaining easy accessibility to the site.

The Panel **noted** the need to encourage research on the validity and relevance of ocean climate indices, particularly from the subsurface ocean.

### 2.2 Overview of IMBER science issues and sustained observing needs

Patrick Monfray, vice-chair of IMBER, presented their science issues and sustained observing needs. IMBER is one of four ocean projects in IGBP today. The talk covered IMBER science issues and implementation activities, the activities of the International Project Office, and related meetings, workshops, and conferences, before focusing on IMBER sustained observations requirements. These sustained observations cover physical measurements, key nutrients in biogeochemistry, ground truthing of remotely sensed chlorophyll a and phytoplankton species in ecosystems monitoring, and ocean carbon measurements. Some key regions for observations included the continental margins, high latitudes and the polar oceans, and the mesopelagic zone from 150-1500 m depth. Sensor development was necessary to improve sustained biogeochemical and ecosystems monitoring, as was improvements in the observational capability and algorithms from ocean satellite missions.

The Panel **encouraged** the use of ship riders that may be on board for high-resolution XBT work or underway ocean carbon (pCO2) systems, as well as OceanSITES time series platforms, for the collection of *in situ* data useful in the calibration and validation of satellite algorithms for biogeochemical and ecosystems variables (**Action**: for chair/secretariat and Hood, to clarify needs and to encourage collaboration between IOCCG, IOCCP, SOOP, OceanSITES, and IMBER).

The Panel **reemphasized** the OceanSITES vision of the time series sites as test sites for new biogeochemical and ecosystems sensors (also including for use in calibrating satellite algorithms), and **encouraged** the use of these platforms for this purpose (**Action**: for chair, Weller, Prien, to bring this up with IMBER SSG and through planning of the ocean sensors workshop, and to publicize this as an opportunity more widely; **Action**: for OceanSITES, to publicize mechanical and power specifications for additional experimental instruments). It noted that this could have mutual benefit: to IMBER research programs as well as to sustaining funding for some of the OceanSITES sites.

To improve systematic data management, the Panel **encouraged** the IMBER data management committee to work with JCOMM on metadata for biogeochemical and ecosystems observations.

The Panel also noted that IMBER would have a connection to repeat hydrography work through SOLAS/IMBER Carbon Group input into the repeat hydrography advisory panel.

### 2.3 Census of Marine Life and animal-based upper ocean profiling

Martin Biuw gave a presentation on behalf Jesse Ausubel of the Census of Marine Life (CoML). The CoML is a decade-long programme (2000-2010) to assess

and explain marine life's diversity, distribution, and abundance, in the past, present, and future. An important component was the Ocean Biogeographic Information System (OBIS), and the expectation was that in 2010 that all ~230,000 marine species will be in OBIS. New technologies and consistent protocols had made global marine biological observation possible, detailed examples can be found in the talk.

Biuw then went on to present work done by himself and others, using animals being studied with biological tags as platforms of opportunity for physical ocean measurements. Improved animal tags and sensor technologies for CTDs and GPS, as well as satellite bandwidth improvements, have allowed a great increase in the volume and geographic scope of experimental data. In the Southern Ocean for example, these animal data provide a large increase in the data near and under the ice edge. Work in merging data from traditional platforms including Argo with the seal-platform data had shown promising results. A number of other technologies for communication between sensor platforms on different animals, using them as nodes, were being worked on.

The Panel **strongly encouraged** the work of the CoML (mentioning it for possible incorporation as a GCOS Essential Climate Variable, although the concept of 'variable' would have to be stretched to match the thousands of variables the Census was measuring). Despite the one-time nature of the design of the Census, it noted that its continuation would provide valuable information about marine ecosystems change, and encouraged a discussion and sharing of best practices.

Biuw noted that at the start of the animal tagging program they had successfully argued for the ethics of these measurements as a tool in better understanding the animal behavior and their potential responses to climate change. The tags fall off after about one year. The CTD animal tag sensors were being produced at a rate of about 200 per year, and a large increase (to greater than about 500/year) would require a change in working methods.

The Panel was impressed by these efforts, and **strongly encouraged** their continuation (particularly in polar regions). The Panel recognized that further work on standards and quality control would be necessary for their full inclusion in the climate observing system (**Action** for Weller and Biuw: to identify an opportunity to attach an animal sensor package to a deployed Argo float for intercomparison and validation of the system). It also **encouraged** the development of standards for measurement methods, the data, and metadata on how the observations were made, noting the importance of this to current and future users of the data outside of the immediate researchers collecting it.

The data streams from the animal tags were being incorporated into at least two GODAE models: the Mercator and MIT ECCO efforts. The Panel **encouraged** the use of this data in GODAE systems, and **solicited feedback** from GODAE on the impact of this data, including how much is retained by assimilation systems compared to conventional platforms, as a measure of quality (**Action** for Biuw and GODAE: to ensure data streams were available on GODAE servers, and to solicit/provide feedback). The Panel **decided** to ask the JCOMM Observations Coordinator to negotiate with Service Argos the inclusion of these measurements into their Joint Tariff Agreement, to bring the now substantial costs of transmission down (**Action** for chair/secretariat).

Detemmerman noted these types of observations as an interesting link between the physics of climate and biodiversity, which could serve as a bridge between WCRP and Diversitas (**Action** for Detemmerman: to explore a link with Diversitas).

## 2.4 Emerging Arctic Ocean climate science and observing system issues

The Panel heard a report on emerging Arctic Ocean climate science and observing systems issues from Jean-Claude Gascard (CNRS France), coordinator of the Damocles Integrated Project. The minimum in sea ice extent in 2005 had renewed popular interest in the Arctic, and many scientific questions remain to be answered. Some of the most pressing are: Is the Arctic system moving to a new state? Is the Arctic Climate as sensitive to global changes as models suggest? To what extent may the Arctic Sea Ice cover retreat or even disappear in this century? What are the consequences of a drastic retreating ice cover for the Arctic? What are the most consequential links between the Arctic and the Earth system? To what degree are recent changes in the Arctic Climate of natural or anthropogenic origin? What are the relevant processes and how well they are represented in global models? What is the predictive capability for the Arctic and what are the optimum components of an integrated forecasting system on seasonal and climate scale? The proper representation of these processes in models was important, and required further research into processes as well as large-scale observations.

DAMOCLES (Developing Arctic Modelling and Observing Capabilities for Long-term Environment Studies) is an EU project funded from 2005-2009, with the general objective of predicting the regional-to-global Impacts of that extreme climatic event on the atmospheric climate variability (AO/NAO), the hydrological cycle, marine ecosystems and biodiversity, the global oceanic MOC, the occurrence of extreme weather events (storms tracks, polar lows), the impacts on indigenous people and the European Community, northern sea routes and marine transportation, large scale industrialisation versus resilience and sustainability and to assess socio-economic consequences for Europe.

A large number of observing campaigns were planned in the Arctic during the International Polar Year (IPY). There were many challenges to integrating observations, some technical but many political. There were also technological challenges to setting up sustained observations in the Arctic. These included the need to:

- develop Lagrangian and Eulerian in situ observations with autonomous, remote and attended platforms
- enhance remote sensing and ground truth validation for airborne and satellite sensors
- shorten the time required for accessing data, develop advanced data assimilation and numerical modelling techniques, and
- improve access to appropriate logistics and infrastructure.

There was also a need to operate new systems over large domain and for long-term applications, involving high data rate transmission in near real time of key climate variables.

The Panel **was encouraged** to see the integration of the European DAMOCLES and US SEARCH efforts, and **encouraged further cooperation** with other interested national observing efforts in the Arctic including those by Canada and Russia. It noted that sharing data amongst partners was a challenge that was overcome by the DAMOCLES-SEARCH partnership, and encouraged this emphasis on overcoming problems in data sharing as a part of further integrating frameworks for Arctic observations, such as the iAOOS, or perhaps a GOOS Regional Alliance for the Arctic. It decided to maintain contact with DAMOCLES, SEARCH, and iAOOS on the legacy of this current technology-proving and research-driven phase of Arctic Ocean observations (**Action**: for chair/secretariat, to maintain contact with DAMOCLES, SEARCH, iAOOS on legacy observations).

## 2.5 Emerging Southern Ocean climate science and observing system issues

Mike Sparrow gave a presentation on behalf of himself and of Kevin Speer on emerging Southern Ocean Science and observing system issues. He covered science and coordination issues surrounding the IPY, including planned synthesis efforts; the observing system in the Southern Ocean, including the Southern Ocean Observing System (SOOS) initiative, new technology and opportunities, and remaining gaps; and indices for the Southern Ocean region. Details can be found in the presentation.

Sparrow noted that he maintained a web site with research cruise plans, and the Panel **stressed** the importance of maintaining communication between the research fleet and scientists and the Argo and DBCP surface drifting buoy programs to take advantage of all appropriate deployment opportunities (**Action** for Sparrow: to liaise with research community and with the Argo and DBCP Technical Coordinators; also considering POGO is planning to bring a cruise database online).

Sparrow also noted that no reinforcement of the ice drifting buoy network (IPAB) in the Antarctic region was planned for the IPY (**Action** for Harrison, Sparrow, and Speer: to assess the need for a reinforcement and if needed identify opportunities)

The Panel **stressed the importance** of the availability of synthesis (reanalysis and analysis) products for the polar regions during the IPY period, to support the intensified research activities (**Action** for Harrison/Speer: to bring this up with GSOP and GODAE). The Panel **noted** however a lack of clarity in responsibility for the preparation of the datasets for ocean syntheses (**Action** for Harrison, Sparrow, Stammer: to clarify responsibility between CLIVAR Southern Ocean Panel, GSOP, SOOS, and other relevant players). The Panel also **encouraged** cooperation between ocean and atmospheric sides on reanalysis (**Action** for Harrison: to contact Adrian Simmons to ensure proper input from CLIVAR Southern Ocean Panel for WCRP Reanalysis Conference in Japan in January 2008).

The Panel also **noted the importance** of wide and quick sharing of data during the IPY in both polar regions in order to support arguments for legacy observations.

The Panel **thanked** the Southern Ocean panel for their engagement on developing and debating ocean climate indices, noting that the debate was important in improving understanding of the important oceanic processes in climate variability. The Panel was encouraged by the development of an improved mooring in the Southern Ocean that was taking place under the U.S. ORION program, noting that its data would in particular help improve knowledge of air-sea fluxes in the region.

## 2.6 Joint OOPC-AOPC (GCOS) Working Group on SST and Sea Ice

### 2.6.1 Sea Ice

Søren Andersen, chair of the Sea Ice subgroup of the GCOS SST and Sea Ice working group, presented the work of his group. This report covered the objectives of the group, its organization, motivation and mission through a number of illustrative examples. The mission of the group is to provide analysis and recommendations on long term consistent sea ice fields with uncertainty estimates for use in SST & SI analyses. Different estimates of sea ice extent in the northern hemisphere show up to a factor of two between the highest and lowest estimates of trends.

The full level of activity will depend on level of community commitment and funding. However, some initial activities are already committed, including the demonstration of intercomparison of a limited set of products, an ice chart-based ice edge uncertainty project, and a commitment to progress through cooperation. The group will initially focus on ice concentration but consider ice thickness as methods and data sets mature. Andersen illustrated his talk with a number of the different processes that can lead to differences in the analyses.

The Panel **commended** Andersen on his work in coordinating and motivating the sea ice analysis community and **endorsed** the work plan of the working group. It noted the attention the IPCC Fourth Assessment Report gave to sea ice variability, and resolved to take advantage of it to promote research and observations (**Action** for Andersen: to pass on examples for the need for work on the consistency of historical sea ice concentration and thickness data, to Harrison and Fischer). The Panel **encouraged** the JCOMM Expert Team on Sea Ice to prepare historical manuals of the ice charting practices by the various involved services.

### 2.6.2 Sea Surface Temperature

Nick Rayner presented the work of the SST subgroup of the GCOS SST and Sea Ice Working Group which chairs. Rayner outlined the work plans of the group, which were to agree to a set of diagnostics and initial set of analyses and input data; to identify a host website and agree on data formats and intercomparison tools; to draft a communication plan, and to turn the differences and similarities discovered into useful information for users. A number of these items had progressed, and the group was in the course of identifying its next full meeting.

The Panel endorsed the work plan of the group. It **encouraged** efforts to take maximum advantage of near-surface profiling temperatures (from XBTs and Argo) to support SST analyses. The Panel **noted** the need for additional research on how to treat SST near the sea ice edge, as resolution mismatches and analysis techniques could cause problems, and there was a clear interest in obtaining SST as close to the ice edge as possible. It **encouraged** the SST and sea ice groups to continue their close collaboration. The Panel also noted that the SST and sea ice reanalysis were critical boundary conditions for atmospheric reanalyses (**Action** for Harrison: to contact Adrian Simmons to ensure a presentation on the available reanalysis datasets for SST and sea ice, including especially information about uncertainty regionally and in time, was included at the January 2008 WCRP Reanalysis Conference).

## 2.7 Discussion of observing system issues raised by science presentations

A recurring theme in Panel discussions was the fact that much of the sustained ocean observing system for climate was being built on research efforts, and that sustaining these observing efforts in the long term was a widespread and continuous challenge. Emphasizing low-frequency variability in the ocean to funders was one way to encourage longer-term commitments to measurements.

## 2.8 Sensor development update and opportunities for global sustained ocean biogeochemical and ecosystems observations; and review of plans for the 2008 ocean sensors symposium

Ralf Prien gave a report on opportunities for global sustained ocean biogeochemical and ecosystems observations based on the development of new sensors. He recalled that new observations and observing techniques were key to driving new ideas in ocean climate research. The challenge was to observe the

ocean system on the appropriate temporal and spatial scales to improve understanding of the particular phenomenon of interest. For biogeochemical and ecosystems variables, this means fairly high space and time resolution, at least as high as observations of physical variables. Physical methods such as optical absorption and microelectrodes, as well as wet chemical analysers with onboard standards were increasingly being used to measure chemical parameters of the oceans. Flow cytometers and environmental sample processors had been developed for ocean deployment, moving from lab-only systems. New and smarter platforms including gliders, autonomous vehicles, and cabled observatories, as well as new communications systems, were also extending the capability of ocean observations.

Prien suggested that the a first necessary step was to promote the development of an ocean sensor community that would be able to share ideas on technology, on science questions, and on funding strategies.

Harrison questioned whether identifying a particular class of sensors or focusing on one of a few variables might be a more focused way of proceeding, an exercise that could be repeated with a different focus. Biuw noted that the CoML and other ocean ecosystems monitoring efforts could benefit from a sensor development push. Prien noted the needed balance as a sensor developer of being driven by a particular science question with a history of observing techniques, but being open to adapting sensor technologies from other uses to the ocean, and that the intersection of these was where new capabilities developed.

Keeley noted the desirability of developing 'plug and play' type data output standards for new sensors so they could be easily adapted to different platforms, and so that the data was easier for users to use.

Harrison noted that the sensor development push would be split in multiple directions depending on the platform. There would be real interest from the system perspective in a push to improve sensors for Argo-type platforms, gliders, moorings, ships, and animals. This would be important input into the recommendations coming out of an OceanObs'09 meeting.

The Panel **outlined** two separate goals to help promote the development of capable ocean sensors. The first would be to work with IMBER, CoML, and other relevant scientific leadership to identify their priority accessible development desires for observing capability. The second would be to promote the development of a sensor community to help development efforts, including through links to funding agencies.

Prien and Weller **agreed** to lead the effort in recruiting a steering committee for the OceanSensors'08 meeting (**Action** for Prien and Weller), which would then decide on white paper topics and recruit authors.

## 3 SPONSORS AND OTHER BODIES

### 3.1 World Climate Research Programme including CLIVAR

Valery Detemmerman of the WCRP Joint Planning Staff gave a report on the status of the WCRP, including CLIVAR, and its interactions with and expectations of OOPC. The presentation covered ocean-related activities in WCRP in the past year, the development of the WCRP Strategic Framework and cross-cutting activities, and a planned review of WCRP by ICSU. The CLIVAR Scientific Steering Group had been examining the legacy of the project and implementation plans. It had identified a number of key aims to achieve by the end of the project in 2013, and wished, with OOPC, to evaluate the current state and development vector of the global ocean

observing system, aiming for a system which is fully sustained and providing key inputs to prediction services.

The Panel **emphasized** the importance of CLIVAR-related research data for climate analysis and research, particularly on the longer time scales - and that preserving this legacy through the preparation and synthesis of these data sets was important (**Action** for chair/secretariat: to work with GSOP (Legler) and WOAP in developing a strategy for a CLIVAR 'data legacy').

The Panel **expressed some concern** at the strength of its connection to the WCRP JSC this past year, **noting** that the WCRP and CLIVAR in particular were critical in sponsoring the development of new capabilities for the ocean observing system, that ocean data was critical for seasonal and longer-term climate forecasts, including those that were evaluated by the IPCC, and that participation of CLIVAR in the OOPC was critical to its functioning (**Action** for chair: to write letter to WCRP chair and director, with copy to sponsors).

### 3.2 Global Climate Observing System

Ed Harrison presented a report on behalf of David Goodrich, director of GCOS. The GCOS Implementation Plan and its 131 suggested actions had been adopted by the UNFCCC and GEO, and nations have been called to implement it. GCOS's relationship with the UNFCCC was strong and central to its future, and new reporting guidelines for progress against the GCOS Implementation Plan had been submitted to the UNFCCC Parties for adoption.

GCOS was also involved in a workshop planned for October 2007 on learning lessons about observations from the 4th IPCC Assessment Report. The GCOS regional workshops accomplished in the past decade had identified regional action plans for improvements in the observing networks, and an Action Plan for Africa had been developed in the past year.

The UNFCCC has asked GCOS to prepare a major report in 2009 on progress and the adequacy of the climate observing system. GCOS asked for input from OOPC on the suggested form and scope of this report. The Panel **noted** that UNFCCC input would be needed in early 2009, which did not fit ideally with its plans for an ocean observations conference in later 2009.

### 3.3 Global Ocean Observing System

François Gérard, chair of the Intergovernmental Committee for GOOS (I-GOOS), gave a presentation on the Committee's priorities for GOOS in the coming year. These included: securing GOOS as the main GEOSS element in the oceans; consolidating GOOS's role in ocean hazards and capacity-building; improving the link with JCOMM to implement the open-ocean module of GOOS and focus on national commitments and sustainability; and to organize the coastal module of GOOS.

The Panel **emphasized** that GOOS and in particular I-GOOS were the global system's path to communication with IOC Member States, and hopefully towards improved commitments to sustaining the system. Harrison noted that many of the GRAs had expressed a desire for improved coastal forecasts of wind, waves, and water level - and that this was both a natural contact point for improved cooperation with the WMO, but also a way for the global observing system to contribute strongly to regional needs. Gérard mentioned that coastal innundation was a proposed focus of the Global Ocean Hazard Warning and Mitigation System, which would involve the WMO and met services. The Panel also asked the I-GOOS to consider linking deployments of climate and tsunami warning moorings, and to emphasize installation

of GPS on tide gauges, so that they could serve multiple purposes for hazard warnings as well as contributing to the climate observing system.

The Panel also drew a parallel between met services, some of which had agreed to take responsibility for observations in remote areas of the globe, and the success of Argo in getting nations to invest in observations far from national waters, in asking whether I-GOOS could seek commitments from nations to observe the open oceans.

### 3.4 Liaison with other bodies: JCOMM, POGO, GEO

Alverson and Lee noted that the CoML and Argo were to be presented as ocean success stories as input for the GEO Ministerial meeting in November 2007 (Cape Town, South Africa), under a 'water' theme that would stress climate change and coastal management. The Panel noted that for coastal management sea level variability would make the strongest connection to the global network. Prediction of regional sea level variability and change required tide gauges, altimetry, profiling floats, and accurate seasonal, interannual, and decadal predictions of the climate system, on a regional scale. The development of the GLOSS network and the link with tsunami warning provided an additional ocean success story (**Action** for secretariat*:* to provide input for the GEO ministerial meeting).

While aware of the pressures to single out individual networks to help identify funding opportunities associated with GEO, the Panel **reiterated** the importance of promoting the entire composite ocean observing system.

## 4 CLIVAR BASIN PANELS

The Southern Ocean Panel was covered in item 2.5.

### 4.1 Atlantic Ocean Panel

Martin Visbeck, the exiting co-chair of the CLIVAR Atlantic Panel, gave a presentation, reminding the Panel of the three major areas of research the Atlantic Panel was interested in: the North Atlantic Oscillation, Tropical Atlantic variability, and the meridional overturning of the ocean, emphasizing interactions between these climate modes. It promoted balanced activities in observations, modeling and theory, and synthesis to improve understanding of the Atlantic. Visbeck reviewed the status of the sustained ocean observing system in the Atlantic sector, and the status of the Tropical Atlantic Climate Experiment (TACE) including its links with AMMA and PIRATA. He highlighted difficulties in sustained some observations of transports, part of the meridional overturning circulation.

Alberto Piola, member of the Atlantic Panel, gave a complementary presentation on observations and research focused on the southwestern Atlantic Ocean. Research has focused on trying to understand the meridional heat flux contribution from the region, as well as the biological productivity and carbon flux in the region.

The Panel **thanked** the Atlantic Panel for its excellent work in keeping abreast of the research and sustained observing needs in the region. It **noted** that the development of syntheses and the delivering of climate products and services was increasingly important in arguing the necessity and importance of the sustained ocean observing system. The Panel **re-emphasized** the importance of the metric intercomparison projects being undertaken by GODAE and GSOP.

The Panel **noted** the persistent gaps in coverage of surface drifters on the equator and in the Gulf of Guinea, and decided to ask the JCOMM OCG and others responsible for a formal plan for surface drifter deployments in undersampled places (**Action** for chair/secretariat). It was **encouraged** by the joint AMMA-TACE-PIRATA meeting that was to take place in November 2007 and **recommended** that these communities should continue to working together (**Action** for chair, to write to chairs of AMMA, TACE, and PIRATA). It encouraged further research on the correlation of transports between the MOVE and RAPID sites, noting that for the moment it was not possible to scientifically prioritize one over the other as being more important.

Weller noted that an ORION mooring would eventually be placed at 42°S, 42°W, near the edge of the high energy region of the Malvinas/Falkland current, and that the support ship for this mooring could provide good opportunities for hydrographic and other work in the region (**Action** for Weller and Piola to maintain communications for coordination opportunities).

### 4.2 Indian Ocean Panel, including Cirene

Jérôme Vialard gave a presentation on behalf of the CLIVAR-GOOS Indian Ocean Panel (IOP), of which he is a member. The major modes of climate variability of interest to the panel in the Indian Ocean include the interannual variability including the Indian Ocean Dipole Mode, and the Madden-Julian Oscillation and monsoon breaks. The IOP has outlined a strategy for sustained observations that includes a moored array being implemented by India, Indonesia, France, Japan, and the USA, completion of the Argo array in the Indian Ocean, XBT lines, including a reactivation of the Mumbai-Mauritius IX-8 line, and an Indian Ocean data portal hosted by INCOIS. A number of process studies complemented the planned sustained observations. Some of the other subjects the IOP planned to address in the future included links between African climate variability and Indian Ocean conditions, decadal variability, the predictability of interannual variability, and surface layer heat budgets. The IOP had also communicated with the OOPC secretariat on Indian Ocean indices and would continue that exchange.

The Panel **encouraged** the INCOIS data portal to make both real-time and delayed mode data available on the GTS for inclusion in ocean forecasts and reanalyses. The Panel **thanked** the Indian Ocean Panel for its engagement in the development of ocean climate indices, and expressed its appreciation that the indices were of an amplitude and time scale that kept human interest, and had societal impact. It **encouraged** the use of *in situ* data for subsurface ocean indices as a complement to altimetry. The Panel **encouraged** the IOP to work also with the AAMP in looking at intraseasonal SST indices (such as a meridional index of SST in the Bay of Bengal or the Arabian Sea, or the Somali upwelling) for monsoon breaks. The Panel **encouraged** IOGOOS to coordinate activities with the IOP.

Vialard then gave a report on early results of the Cirene experiment which took place in January-February 2007. The experiment sought to understand the processes driving the SST in the western tropical Indian Ocean, to capture the biogeochemical response of the ocean to the MJO, and to explore ocean feedback on the atmosphere. The MJO was not active during the field experiment, but a cyclone passed through and its induced cooling mornitored in large detail.

### 4.3 Pacific Ocean Panel

Toshio Suga gave a presentation on behalf of the CLIVAR Pacific Panel. The science priorities of the Pacific Panel were broad, and included investigations of the failings of coupled GCMs in simulating the cold tongue and the southeast Pacific

climate, questions surrounding the interactions between ENSO and other modes of variability, decadal variability, western boundary currents, and observations needed for these questions. Suga outlined the observational requirements for the various science questions including ENSO sensitivity to climate change, ENSO – westerly wind burst interactions, understanding the SPCZ, improving model biases (in the eastern tropical Pacific and the SPCZ), and understanding interbasin connections on interannual to decadal timescales. He gave an overview of the SPICE experiment which was a process study dedicated to a better understanding of the circulation in the southwestern Pacific Ocean. Finally he noted that the South Pacific was undersampled compared to the North Pacific, and stressed the need to improve observations and integrated data products in the region.

The Panel **thanked** the Pacific Panel for its suggested indices, and looked forward to future engagement and exchanges with the panel.

## 5 OCEAN PRODUCTS: ANALYSIS AND REANALYSIS

### 5.1 Report on GODAE including final symposium plans

Pierre-Yves Le Traon gave a presentation on the status of the Global Ocean Data Assimilation Experiment (GODAE). He reminded the panel that the experiment was due to end in 2008, at the end of its operational demonstration and consolidation phase. GODAE had served to develop and consolidate national ocean forecasting systems, develop joint data and product serving capability, provided a framework for product assessment and intercomparison, as well as the launching point for pilot projects.

GODAE's priorities for the final two years of the experiment were to demonstrate the utility of ocean forecasting products, including the development of standardization and error characterization; to demonstrate the value of the observing system; to work with JCOMM on a transition to operational systems; and to develop new research initiatives in coupled ecosystems forecasting and coastal forecasting. Le Traon also outlined the goals of the EU GMES Marine Core Services and European operational oceanography, including the collaborative myOcean project.

The Panel was **encouraged** by the development of a European infrastructure for operational oceanography including support for observations.

### 5.2 Review of plans for the November 2007 OSE/OSSE meeting

Le Traon outline the objectives of a planned November meeting on ocean Observing System Evaluation (OSE) and observing system simulation experiments (OSSEs). It would be a first encounter around this subject, and would have the goals of reviewing past work, identifying robust and common results from OSEs and OSSEs, identifying good examples of the contribution of the observing system, and to develop a roadmap for recommendations on observing system design.

The Panel would actively participate in the organization of the workshop. It also **noted** that an optimization of the observing system for operational oceanography (i.e., mesoscale ocean prediction) might be different from that for climate research and forecasting. But it **encouraged** the workshop and the use of its results to help underpin arguments for the observing system.

### 5.3 CLIVAR Global Synthesis and Observations Panel

Detlef Stammer, chair of GSOP, gave a presentation outlining the activities of GSOP and intersections with the OOPC. GSOP is charged with the promotion and development of global ocean, atmosphere, and coupled climate syntheses, with an initial focus on global ocean synthesis. In collaboration with OOPC and other bodies it is responsible for CLIVAR's global needs for sustained observations. It also carries responsibility for CLIVAR flux data sets, data management and information needs, and for liaison between CLIVAR panels to identify observing requirements. The evolving WCRP strategy was to move to 'seamless prediction' across all timescales and to including non-physical variables. CLIVAR has a sunset date of 2013 and is in the process of defining its legacy and follow-on. It hoped to have developed a global description of subsurface ocean variability, and to have in place a truly global ocean observing system.

The 14th CLIVAR Scientific Steering Group meting asked GSOP to lend CLIVAR support to the creation of an OPSC (see section 7.8), to identify and coordinate development of CLIVAR reference datasets, and to develop plans for an ocean observations meeting (see section 8). Stammer then presented results from GSOP climate synthesis intercomparisons, which had proved valuable for evaluation and spurring questions from the research groups involved. The intercomparison work was expected to continue.

Stammer noted that one challenge for ocean reanalysis was that CLIVAR's requirements varied depending on the climate problem at hand: seasonal-to-interannual prediction, or decadal-centennial prediction. These would probably continue to require different approaches for assimilation and modeling, and would have different needs for accuracy and robustness. First steps towards coupled (ocean-atmosphere) reanalyses were also being taken.

The Panel discussed difficulties in defining error in observations for reanalyses – as the error included observational accuracy as well as representational accuracy, with ocean scales of variability being much smaller than models were capable of representing.

Fischer agreed to pass the message of support for the OPSC from CLIVAR on to JCOMM (**Action**). The Panel was **grateful** for the support of CLIVAR for the development of the OceanObs'09 meeting. The Panel **recognized** the importance of standard datasets for the ocean reanalysis effort, including a standard for air-sea fluxes, and **encouraged** the WCRP/SOLAS surface flux group to work on this. However integrated datasets for XBTs, hydrography, polar observations, and others remained as outstanding problems.

The Panel also **agreed** to work as closely as possible with GSOP in the development of web display of ocean climate indices (**Action** for Fischer, to work with Stammer and GSOP secretariat)

## 6 DATA MANAGEMENT

Robert Keeley gave a presentation on Data Management from the perspectives of JCOMM and IODE to the Panel. Within the JCOMM Observations Programme Area a number of activities with each of the JCOMM and other associated panels were ongoing, including at the coordination group level, with the Ship Observations Team, Argo, and a Meta-T pilot project to deliver metadata relevant to SST observations. In the JCOMM Services Programme Area activities centered around the GHRSST and the Expert Team on Wind Waves and Storm Surges. The JCOMM Data Management Programme Area had a large number of

activities centered around its expert teams and in cooperation with WMO efforts. Details of these many projects can be found in his presentation. Keeley asked the OOPC to provide direction on the highest priority data mangement activities, and to encourage research programmes to cooperate early with national and international data systems, to encourage convergence to standards, and to encourage the early submission of data to data systems.

The Panel **expressed concern** that the proposed SOT ship masking scheme for real-time VOS reports was overly complicated, and could potentially compromise the stream of data into climate archives. It **encouraged** rapid implementation of the proposed final encoding scheme.

Regarding the need for high-quality CTD casts in near-real-time for the delayed-mode Argo Quality Control, the Panel **decided** to ask the advisory group for repeat hydrography to take up this issue. It **suggested** a solution could involve asking SeaBird to set CTD firmware up to deliver Argo-style GTS messages, but also recognized that hydrography operators should have simple one-stop procedures for submitting their data after quality control. It **suggested** the writing of a 'cookbook' of how and where to submit data to Argo, and noted that implementation would require a build-up of trust that this data would only be used for Argo QC and not widely released (**Action** for chair, to ask advisory group for repeat hydrography and Argo ST to take up this issue).

Noting that until good progress was made in completing Master Table 10 for BUFR codes as a standard, new data types would continue to proliferate, and the Panel **suggested** the start of a pilot project for one observing network.

The Panel **noted** an increased usage of Iridium and other alternatives to Service Argos for real-time transmission of data from remote platforms, and that the procedure to get data onto the GTS from these alternate pathways was not always clear to the operator/researcher. It **decided** to develop a quick 'cookbook' of how to get data onto the GTS (including the formats and the key players that could help) from these alternate pathways (**Action** for Keeley: to write this cookbook).

The Panel was encouraged by the proposal for an IODE-JCOMM "standards summit" in November 2007 as a positive step forward.

# 7 GLOBAL OBSERVING NETWORKS

## 7.1 Ocean Satellite Observations

### 7.1.1 Missions update and the CEOS and GCOS reports to the UNFCCC

Jean-Louis Fellous, CEOS Executive Secretary and JCOMM co-president, gave a presentation on opportunities arising from the CEOS-GCOS dialogue. He outlined the background of GCOS Essential Climate Variables and decisions of the COP relating to satellite observations for climate. The detailed satellite supplement to the GCOS Implementation Plan had provoked a response from CEOS that had engaged all of the satellite agencies. It outlined some of the potential future data gaps, and variables which had less than adequate coverage. CEOS has a new implementation framework to inspire and facilitate commitments, 'Virtual Constellations'. Ocean surface topography will be one of the four prototype constellations. The CEOS report to the UNFCCC noted that unless additional urgent actions in response to relevant GCOS requirements are taken, only observations for the SST ECV will be adequate in the next six years. The report outlined a number of CEOS considered actions, and also addressed the access to data. In response, SBSTA invited the Parties that support space agencies to enable these agencies to

implement, to the extent possible, the actions identified in the CEOS report, and to continue responding in a coordinated manner through CEOS to the efforts to meet these needs.

The Panel **appreciated** the response from CEOS to the GCOS satellite requirements. It **reiterated** the importance of continuity in microwave SST satellite observations. It also **encouraged** the CEOS agencies to continue coordination of their actions as outlined in their response (**Action** for chair, secretariat, Fellous: to draft a letter from OOPC and suggest a letter from GOOS to CEOS).

The Panel noted that surface vector winds were a critical ocean variable as well as atmospheric variables, and **asked** GCOS to identify surface vector winds as an ocean variable (**Action** for chair/secretariat, to bring to GCOS secretariat).

### 7.1.2 IGOS Partners

Keith Alverson spoke about the relationship between IGOS and GEO. IGOS had focused on strategies for observations in thematic areas, and the ocean theme of IGOS was a player in ensuring some successes in building up the ocean observing system, particularly in the satellite domain. IGOS was now facing GEO/GEOSS, made up largely of the same partner organizations, but organized around social benefit areas. A meeting at the end of May 2007 would decide how IGOS and GEO would work together and map a way forward. Alverson also felt it was important to clearly identify the audience of a revision to the IGOS Ocean Theme report before completing it.

The Panel **noted** a key difference between GEOSS and IGOS, which has been the IGOS focus on research for observing system development, and on the possibility of breakthrough measurements. This was a complement to GEO and to GCOS, which has focused on sustained observations for which the development of techniques is mature. IGOS could continue to push for breakthroughs such as wide swath altimetry or hyperspectral color measurements, continued improvement in algorithms, and new in situ techniques such as gliders, new capabilities for profiling floats, and making the connection between the physics of the ocean climate variability and change and fisheries (**Action** for secretariat, to bring this point to the upcoming 30 May 2007 IGOS meeting).

### 7.1.3 Ocean Surface Salinity

The Panel **noted** plans for the future launch of SMOS and Aquarius surface salinity missions, and the need for accurate near-surface *in situ* salinity measurements for calibration and validation. These observations include those taken from moored buoys, from VOS and research ships, from Argo floats, and a limited number of surface drifters. Each was subject to difficulties from sensor drift and fouling, and in some cases the lack of a true surface measurement. The calibration effort will be complicated by the small scales of salinity variability at the surface. The Panel did not believe further observations were required, but **noted** that the data archiving systems, particularly for metadata, and the understanding of the error characteristics of each type of surface salinity measurement, would have to be improved. The Panel **encouraged** JCOMM and POGO to work with the surface salinity DAC (Coriolis/GOSUD) in improving the surface salinity data systems and appointed Le Traon and Visbeck as point persons for the Panel on this effort.

## 7.2 Data Buoy Cooperation Panel

Boram Lee presented a report from the Data Buoy Cooperation Panel (DBCP) including a status report on the state of the network, and with a focus on potential

expansion of capabilities for the surface drifting buoy network, including more frequent reporting of SST and the addition of wave measurements.

The DBCP Data Users and Technology Workshop (27-28 March 2006, Reading, UK) noted interest amongst a number of data users (numerical weather prediction, operational SST analysis, climate research) in SST data that resolves the diurnal cycle. The workshop asked DBCP to respond to this perceived requirement, and DBCP-22 asked OOPC to provide a detailed rationale and documentation for this requirement. They sought in particular a definition of the hourly SST value, requirements for the timeliness of real-time data transmission, the time and space resolution, data quality, and number of buoys. The DBCP Evaluation Group will look at practical technical solutions and cost impacts.

DBCP-22 also recommended adding wave measurements to the DBCP implementation strategy, based on user requirements communicated via the JCOMM Expert Team on Wind Waves and Storm Surges and OOPC.

*High frequency reporting of SST and SLP from drifting buoys*

The Panel **apologizes** for any misunderstanding of the requirement transmitted to the DBCP. It was the impression of the Panel that it was feasible, from a technical and energy budget perspective, for some of the existing drifting buoys to report much more frequently than they have been programmed to do. Were this feasible without increasing the costs of the buoys, it would be scientifically desirable to obtain as much information as possible about higher frequency variability of both SST and SLP.

For climate purposes, the Panel **noted** that it had requested a no- or low-cost and no/low-impact on lifetime (not more than 5% change in cost/lifetime) solution that could contribute to documentation of variability on sub-diurnal scales - which does not imply hourly reporting.

The SST analysis community including GHRSST was also interested in this data, but does not require real-time reporting, as the information on higher frequencies would be used in the calibration of algorithms. A limited subset of the surface drifting buoys would be needed to provide an adequate base of observations to be useful for SST analysis and climate research.

The Panel **noted** that it could only speak to climate requirements, and that requirements for numerical weather prediction (NWP) including the lag in real-time transmission of data would have to be solicited from the WCRP-CAS Working Group on Numerical Experimentation (WGNE) or THORPEX. It also noted that generally for NWP 3-hour data was the norm. Resources would have to be made available by the NWP community to bear any additional costs of provision of data within the 3 hour synoptic reporting period.

*Surface wave and other observations from drifting buoys*

Regarding observations of waves and other variables, the Panel **noted** that from the point of view of climate requirements, implementation of these on surface drifting buoys was low priority. Implementation of wave measurements as a pilot project on a few OceanSITES reference sites is the recommended way to increase knowledge of open-ocean surface wave records for wave climatologies and research.

The Panel **decided** to transmit this message to the DBCP and OCG, also **commending** the operators of the DBCP surface drifting buoy network in their successful delivery of SST and SLP measurements for climate. The Panel felt that actions that would have potential negative effects on this successful delivery of observations should be carefully considered. (**Action**, for chair/secretariat)

### 7.3 Ship Observations Team

Albert Fischer gave presentations on behalf of Elizabeth Kent and David Barry (VOSClim) and of the SOOP Implementation Panel. VOSClim responded to the need for high quality observations and metadata in order to better compute global ocean surface fluxes. VOSClim data were better than average, in particular in the consistency of the data, but sampling uncertainty was still a problem in many regions – more data was needed. There was not improved data flow and volumes in the VOSClim dataset.

SOOP had a new chair, Gustavo Goni of NOAA/AOML. The panel had firm feedback on the non-feasibility of certain routes (IX-09S, PX-21, PX-35, and PX-81) in the 1999 Upper Ocean Thermal review recommendations due to the lack of reliable ships repeating the routes. However two routes had been restarted: IX-08 Mumbai-Mauritius (India, with support from NOAA/AOML) and PX-11 Australia-Japan (Australia). SOOP was devoting a major effort to improving understanding of XBT fall rate differences, doing intercomparisons and working with Sippican (XBT manufacturer), the research community, and XBT operators. The group will adopt a real-time quality control standard based on Argo QC procedures, and Charles Sun (NODC) and Ann Thresher (CSIRO) among others were working on a common delayed-mode quality control. SOOP would like OOPC to revisit the recommendations from the 1999 Upper Ocean Thermal review in light of changes in the overall observing system.

The Panel **encouraged** the efforts to pursue research on the XBT fall rate equation, and encouraged the proper archiving of metadata to allow for future correction of the historical record.

### 7.4 GLOSS Tide Gauge network

Thorkild Aarup gave a presentation on behalf of Mark Merrifield, chair of the GLOSS Group of Experts. There are four GLOSS data streams:

- Delayed mode, quality controlled Mean Sea Level (MSL) data to the PSMSL (Liverpool, UK)
- Delayed mode, quality controlled higher-frequency data (e.g. hourly heights) to a GLOSS Data Centre (PSMSL or UHSLC)
- Real time/Fast data to GLOSS Fast Centre at UHSLC and where relevant international tsunami warning centers
- GPS data to IGS/TIGA Centre (Potsdam, Germany) initiated in 2001.

A large number of upgrades in 2007-2008 were expected, due in large part to renewed interest in sea level observations for tsunami early warning systems. It was expected that by the end of 2008 70% of the gloss stations would be operational. About 30 of the stations were hampered by national restrictions concerning the exchange of high-frequency data, and another 30 were hampered by the lack of infrastructure and/or technical capability to install gauges. About 80 stations in the GLOSS Core Network have GPS or DORIS stations nearby.

The June 2006 workshop on *Understanding Sea level Rise and Variability* noted that in order to best reduce the uncertainty in sea level monitoring and prediction, tide gauges should have co-located georeferencing to allow for a clear separation of sea level variations from land movement variations. The Panel **encouraged** GLOSS to consider increasing the number of stations with co-located georeferencing. The Panel also **invited** GLOSS to develop global and regional indices of societal relevance which can be updated on a regular (at least monthly) basis, either purely from tide gauge data, or from a combination of tide gauge and

altimeter data. It also **urged** GLOSS to continue working on maximizing the availability of near real-time time series from GLOSS stations.

### 7.5 Argo

Fischer gave a presentation on behalf of John Gould and Argo. The array continued to grow, and was at 95% of the planned 3000 sustained floats in April 2007. It was expected to reach 3000 floats during the year. Float life continued to improve with time, and more countries were becoming involved in the project. There was a small hemispheric imbalance in the number of floats (the north being better sampled). Data quality, in particular problems with pressure measurements, was a recent high-profile concern for Argo.

Argo was entering a sustained maintenance phase, and would need to sustain funding, improve float lifetime, and continue to work on deployment opportunities. This phase would end when Argo had successfully maintained five years of 3000±250 floats. Argo was collaborating with others on the development of new sensors, although that created potential issues with the collection of data in EEZs.

The Panel was **highly encouraged** by the quick development of the Argo observing network. It emphasized the need for a quick delayed-mode quality control. Keeley noted the need for Argo to standardize the data coding from different manufacturers and generations of Argo floats (**Action**, for chair/secretariat to pass this message on to the Argo Steering Team). The Panel also **encouraged** the development of oxygen on Argo as a pilot project (see also 7.7.2), and the efforts to develop Argo floats capable of operating under sea ice.

### 7.6 OceanSITES

Bob Weller gave a presentation on behalf of OceanSITES. The project had worked on developing the potential of the time series observing system, deployed sites in the Kuroshio Extension (KEO) and Gulf Stream regions, and were improving the cross-links between networks. In general OceanSITES did not put data on the GTS, to maintain an independent field for verification. OceanSITES was a volunteer group liaising with the JCOMM Observations Programme Area, and wished to improve data management/sharing, advocacy, the tracking of performance and quality control.

The Panel was **encouraged** by the development of OceanSITES and for the hard work the community was putting in. Harrison again emphasized the development of some simple indices/indicators to communicate about the achievements of the time series sites. Weller indicated that these could be based on surface flux anomalies, or from heat content anomalies in the water column, which would depend on real-time telemetry of subsurface observations.

### 7.7 Ocean Carbon

#### 7.7.1 IOCCP overview

Maria Hood gave a presentation on behalf of the International Ocean Carbon Coordination Project, which seeks to be a central information source about ocean carbon observation programs and research activities, and an international forum to address compability and comparability issues to ensure that the results from individual efforts can be combined. These observing platforms were ship-based hydrography, volunteer observing ships, and time series sites.

The hydrography network's goal was to constrain basin-scale decadal changes in anthropogenic $CO_2$ to ±20%. Its global survey was half complete and on track for completion in 2012. The IOCCP was also participating strongly in a joint CLIVAR advisory group on repeat hydrography, which will define a network for tracking, incorporating needs and contributions from other programmes. It would also review and provide guidance on the need to update the WOCE hydrographic manual. The lack of high-quality nutrient data was a potential block to truly estimating anthropogenic $CO_2$.

The goal of the surface carbon network was to constrain seasonal to interannual variability and climate sensitivity of basin and global scale $CO_2$ fluxes. There was a 60% increase in the number of underway lines since 2005, and a commercially-available pCO2 system was now available. There was a planned intercomparison experiment for observing systems, and the synthesis effort in the North Atlantic was underway.

The time series network was not as strongly coordinated as the other two, lacking an agreed science goal. A census includes buoys and ships, and showed a large increase in the number of stations measuring carbon in the ocean open. Sensors for parameters such as DIC, alkalinity, nutrients, and biogeochemistry were limiting. IOCCP was cooperating increasingly with OceanSITES in the development of the time series network.

The Panel was **encouraged** by the work of the IOCCP and the strong networks that were resulting. The Panel **was pleased** by development of the advisory panel for repeat hydrography.

### 7.7.2 Oxygen on profiling floats pilot project

Roger Dargaville gave a presentation on the Oxygen on Argo pilot project. A white paper led by Nicolas Gruber outlined the scientific justification for measuring oxygen, which is sensitive to changes in physical circulation and biology. New sensor technology meant that drift and accuracy are within the required limits for long deployments. A pilot project would deploy about 100 floats in the North Atlantic and North Pacific, and be accompanied by biogeochemical modeling studies to estimate export production. The SOLAS/IMBER Carbon Group will oversee the next phase of this project.

Hood noted the concerns of the Argo Steering Team regarding float lifetime and difficulties with deployment in EEZ waters. The pilot project would allow a better estimation of the density needed.

The Panel **noted** the concerns of Argo that the oxygen on profiling floats pilot project be complementary to the primary goals of the Argo array, and **wished** the project success.

### 7.7.3 Repeat hydrography: development of a IOCCP-CLIVAR/GSOP-IMBER/SOLAS advisory panel

This item was covered in section 7.7.1 above.

## 7.8 Development of an Observing Program Support Center

Candyce Clark gave a report on behalf of Mike Johnson, the JCOMM Observation Programme Area Coordinator. JCOMMOPS in Toulouse currently served the DBCP, SOT, and Argo, and discussions were underway to identify ways in which an expanded Observing Programme Support Center (OPSC) could support

further elements of the ocean observing system. Requirements for an expanded center had been identified, and a call for proposals would be issued.

The Panel **encouraged** JCOMM in its process, seeing an expanded OPSC as an important contribution to building a sustained ocean observing system.

## 8 WORKING SESSION ON A 2009 OCEAN OBSERVATIONS CONFERENCE

The Panel considered the development of a 2009 ocean observations conference (tentatively title OceanObs'09) as requested by its sponsors (GCOS, GOOS, and WCRP). Harrison gave an overview of the rationale, the requests, and the opportunities of holding the conference. The meeting would review the recommendations that developed from the OceanObs'99 conference held in San Rafaël, France, progress in the implementation of the in situ, satellite, data system, and synthesis/forecasting activities in the past decade. It would provide an opportunity to focus on technology issues and opportunities that were expected in the coming decade, particularly for ocean biogeochemistry and ecosystems observations.

The Panel and the co-chair of GODAE (Le Traon) **decided** that the 2008 GODAE final symposium and OceanObs'09 would be different and complimentary events, one year apart. While somewhat reluctant to add yet another meeting to a busy calendar, the Panel **felt it important** to move forward, **deciding** to work closely with CLIVAR and GSOP in particular in the organization of the meeting.

The Panel **noted** the importance of reaching out to an audience beyond ocean scientists in presenting the need for the sustained ocean observing system. This should include an effort to better understand and capture the requirements of industry for ocean information, and would be an important enlarging of the scope from the San Rafaël meeting. The Panel also noted the importance of the coastal ocean in the societal impact. A theme that would be continuous between the planned 2008 GODAE final symposium and the OceanObs'09 meeting would be the crucial importance of sustaining the observing system, and the Panel believed that the GODAE final symposium would have strong input into the OceanObs'09 meeting.

The San Rafaël meeting had a strong focus on selling the pilot projects and technologies that were ready for deployment. Some members of the Panel felt it important to identify those new areas of observing network development that were ready for global deployment or pilot project deployment, while others thought it important to think of a different audience and to work on the selling of the ocean observing system for societal benefit. The Panel **agreed** that underlining the need to sustain and build on the achievements of the past decade were also a high priority for the meeting. Some members of the Panel felt that climate was still and would still be the largest customer of the ocean observing system, but that 'climate' had broadened in context to include the impacts and vulnerability of human societies to climate, including variability, and that moving focus provided a new opportunity for the OceanObs'09 meeting.

The Panel **identified** a need to collect examples of how ocean observations and more specifically climate information created from those observations had impact on society.

The Panel **suggested** that the adequacy of the current recommendations for a fairly low-resolution *in situ* sustained ocean observing system for building a dynamically-consistent climate reconstruction should be re-examined or at least highlighted as an important issue, in preparations for the meeting.

## 9 REVIEW OF DECISIONS, RECOMMENDATIONS, AND ACTIONS

The decisions and recommendations of the Panel are highlighted in bold in the text, while the list of actions decided during the meeting (also in bold in the text) is summarized in the table below:

*[insert table]*

## 10 NEXT MEETING AND CLOSING

The Panel agreed to meet in the second week in June of 2009, and it was later decided that it would meet hosted by Alberto Piola in Argentina.