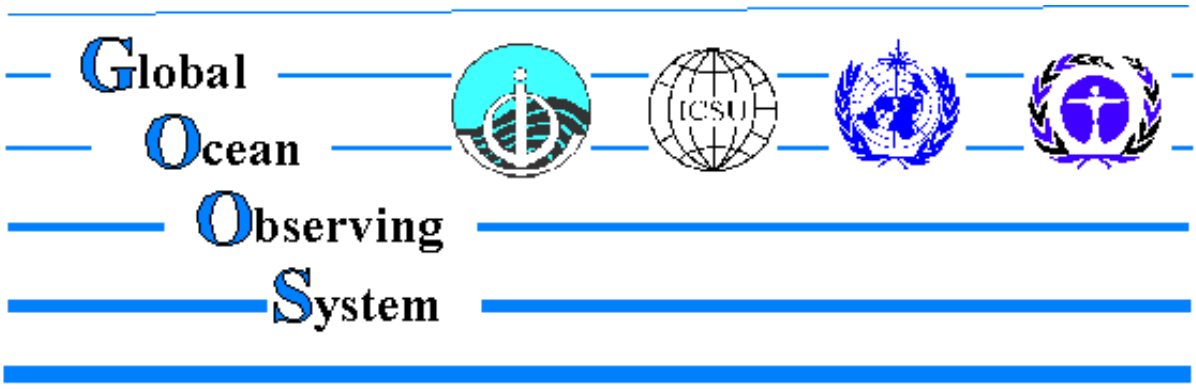

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC)

Seventh Session

Kiel, Germany
5 - 8 June 2002

GOOS Report No. 124
GCOS Report No. 81
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GCOS-GOOS-WCRP/OOPC-VII/3
Paris, 16 December 2002
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ABSTRACT

This report records the discussions, conclusions, and action items resulting from the 7th session of the OOPC. Ongoing experiments, the state of national commitments to GOOS, carbon observations, future data management systems, and planning for Workshops in the South Atlantic and Indian Ocean were a particular focus of this session. Responsibilities were assigned to carry out decisions arrived at for the following actions:

. Provide nominations to GSC to replace members Neville Smith (chair) and Walter Zenk;
. Begin planning the second OceanObs99 Conference (perhaps with JCOMM);
. Improve OOPC interactions with PICES, ICES, operational sea-ice activities.
. Continue direct assistance to GCOS with Second Adequacy report;
. Increase OOPC's attention to polar issues;
. Consider AOPC requests made to the SST/Sea Ice Working Group (Reynolds);
. Review COOP Strategic Design Plan and participate in next COOP meeting;
. Make National Reports available to Bert Thompson;
. Assist WCRP in forming a group to push for specific satellite observations;
. Develop items for POGO meeting scheduled 22 January 2003, Hobart;
. Increase OOPC Travel budget to reflect increasing coordination demands;
. Pass OOPC thoughts on Tropical Mooring Review to managers;
. Press JSC and CLIVAR SSG on importance of continued focus on improving air-sea fluxes;
. Press JCOMM and other met groups on importance of VOSClim;
. Develop items for CLIVAR reanalysis workshop for COP-VIII.

A small working Group was formed to look at mean sea level pressure with AOPC in the context of a GCOS.

Individual members were assigned OOPC responsibilities for participating in workshops and working groups, namely: an International Workshop to review the Global Tropical Mooring Network; a workshop on integrating South Atlantic observations; an Indian Ocean Conference on Sustained Observations for Climate: studies on Data Identification Coding, Versions (levels) and Integration; the preparation of a paper that sets out the issues in full and complete communication of original data (e.g., broad band, 2-way, multi-disciplinary) for general consumption; and the development and use of Ocean Climate Indices.

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SUMMARY REPORT

ANNEXES

1. OPENING

Chairman Neville Smith opened the meeting and introduced Professor Jürgen Willebrand, IFM-UNI Kiel, who welcomed the Panel to Kiel. Willebrand described the new structure of the Institute. He then wished the Panel well in its work and indicated that he would like to sit in on the session from time to time as his scheduled allowed. As he is co-chair of the CLIVAR SSG, he particularly wanted to participate in discussions concerning the CLIVAR-related agenda items.

Smith introduced new members Yutaka Michida and Peter Taylor. Annex II contains the complete list of participants. Smith confirmed that he would be stepping down as chair of OOPC after this meeting and that Ed Harrison would be the new chairman. This would also be the last meeting for panel member Walter Zenk as well as for Arthur Alexiou who has been the IOC Technical Officer for the Panel since its inception. Alexiou will be temporarily replaced by Maria Hood at the IOC until a full-time replacement is found.

Smith commented that this meeting should mark a shift from planning and implementation to review/evaluation, prioritization/rationalization and selected enhancements. He reminded the panel that the OOSDP began with a mandate for **?**conceptual design"; the OOPC went the next step toward implementation and sustained operation. With OceanObs99, we consolidated progress in that arena and are now moving more toward review. We should take stock of the projects we have in place, decide whether we have the right mix of design, work, pilot projects, etc., and make adjustments that reflect what we have learned.

2. REVIEW AND ADOPTION OF THE AGENDA

With the above comments in mind, Smith introduced the provisional agenda and noted that the scheduling of some items might have to be changed to accommodate the expected arrival times of certain speakers. After limited discussion the agenda in Annex I was adopted.

3. PANEL REPORTS ON INTERSESSIONAL ACTIVITY

3.1 OOPC SUMMARY

Smith reported the OceanObs99 volume is going well. Of the 750 printed, about 150 remain. The plan is to put the pub on the web and provide electronic updates of the chapters. CD copies will be prepared and distributed to all the authors. A second OceanObs99 Conference for an update (perhaps with JCOMM) should be considered but not soon. It should be taken up at OOPC-VIII.

Smith made several brief observations relating to OOPC relationships with other groups. He suggested that we needed to improve OOPC interactions with PICES and ICES and asked that Harrison attend PICES meetings, and Keeley ICES meetings. Smith also wished to strengthen ties with operational sea-ice activities. This is partly happening through the SST WG involvement of Vasily Smolyanitsky. Dick Reynolds agreed to assist here.

3.1.1 JCOMM

Smith reported on his impressions from JCOMM-1 in Akureyri. In his estimation, the biggest issue for OOPC was how remote sensing data would be handled in the future. He also was concerned that JCOMM lacked a real services program which he believed OOPC should continue to push.

OOPC had been invited to comment regarding the restatement of the Ocean Obs99 rationale in the JCOMM Observations Coordinating Group (OCG) report in which sea level has been separated out. It is OOPC's view that the restatement weakens the original rationale and prefers that the original statement be strictly used. OCG should emphasize the importance of sustaining what we have in addition to recommending enhancements to the system.

Keeley presented recent progress on the OCG metric project, showing a series of maps for the degree of sufficiency of observations to the required time/space resolution. Discussions brought out that the integration and the co-existence of the observing system network components is critical for overall effectiveness and performance. Metrics considered thus far do not evaluate the integrated network attributes. Perhaps we need two classes of metrics, one to monitor outputs of individual components and another to monitor the integrated result of the total system. It is the integrated performance of the interrelated components of VOS, Argo, satellites, that is crucial.

Taylor raised a point that may have gone unnoticed. One must go through a WMO chain of approval on JCOMM ocean-related matters. The Commission on Basic Systems will be ruling on ocean observations. No action was identified as needed now, but this issue should be closely watched by OOPC.

3.2 GCOS

3.2.1 The Second Adequacy Report

Smith commented on the progress of the preparation of the GCOS 2nd Adequacy Report for the UNFCCC. The national reports that were requested by GCOS for this exercise were complex and revealing to the nations that prepared them. Clearly, the request was taken seriously and a lot of effort was put into them. Smith and Harrison agreed to participate in the preparation of the report and will base their approach on the rationale outline. The consensus seems to be that a parameters list must be provided using the US Oceans list as a start. The feasibility-impact diagrams employed in the OOSDP Final Report will be adapted for use in the Adequacy Report. Annex III lists the questions to be addressed and the approach adopted for parameters being covered in the report.

3.2.2 GCOS Steering Committee

The Steering Committee (SC) expressed its appreciation to the OOPC for its contributions to the substantial progress made in implementation of the ocean observing system for climate. It noted in particular the progress in the GODAE pilot project and its Argo initiative; the definition of a pilot system of global ocean time-series observatories; and the continuing augmentation of the activities of JCOMM as the formal implementation body for the ocean observing system.

The SC expressed its sincere thanks to the outgoing Chairman of the OOPC, Dr. Neville Smith, for his outstanding leadership of the Panel since its establishment and his untiring dedication to the achievement of its goals. It welcomed Dr. Ed Harrison as the new Chairman and confirmed its continuing support for the activities of the Panel.

The SC concurred with the suggestion that the OOPC could increase its attention to polar issues and requested that incoming Chairman Harrison take this into account in setting priorities for future activities of the Panel.

3.2.3 GCOS Workshops

From the review of GCOS workshops held on the Pacific, Africa and the Caribbean, Smith concluded they were WMO-oriented and not particularly useful from an ocean point of view. It should not be implied that they are addressing the OceanObs99 agenda. OOPC should plan to organize its own workshops as needed.

3.2.4 GCOS AOPC

Harrison reported briefly on results of the recent AOPC meeting that related to OOPC. He noted progress on establishing Baseline Systems (see OOPC-VI sec 3.4). This concept is in line with OOPC concepts of a reference network of high-quality observations (VOSClim, SURFA, time-series stations) to obtain the best possible estimate of a field at a particular time and area. The AOPC endorsed the continuing OOPC efforts to improve knowledge of marine surface conditions and to establish ocean time series reference stations that include carbon observations. Continuing interest was also expressed in results of the AOPC/OOPC joint working groups on SST/Sea Ice and Surface Pressure. AOPC expressed appreciation for the collaborative effort with OOPC on marine surface parameters in the UNFCCC Second Report on the Adequacy of the Global Climate Observing System over the next year.

An AOPC Implementation Plan (IP) has been prepared and posted for review. Harrison will ensure that OOPC members receive a copy of the Plan. It calls for three Baseline Observing System activities:

- GSN (Global Land Surface Network),
- GUAN (Global Upper Air Network),
- GAW (Global Atmospheric Watch) chemistry.

The IP recommends increased international effort in ‘climate analysis’ including ‘data synthesis’ products and ‘reanalysis products’. Harrison noted there is no ‘Baseline Observing System’ for the marine surface in the AOPC IP.

Harrison reported that the joint Surface Pressure Working Group which is co-chaired by Rob Hanley of the Hadley Centre and Harrison himself, identified two primary tasks:

- evaluate “homogeneity” of historical data sets (land and marine) and propose adjustments if deemed appropriate; and
- evaluate operational surface pressure analyses and propose observational efforts to improve them.

Chris Folland and David Parker reported on the Workshop on Historical Marine Data at Boulder in Jan 2002. That group made several requests of the SST/Sea Ice Working Group and the Surface Pressure Working Group. They want:

- to encourage increased effort on sea ice
- to add nighttime marine air temperature data and analysis to the SST Group.
- to add marine surface wind data and analyses to Surface Pressure Group.

3.3 GOOS

3.3.1 GOOS COOP

The GOOS Coastal Ocean Observations Panel completed a draft of their Strategic Design Plan and invited review and comment from OOPC. OOPC welcomed the opportunity; Tommy Dickey, Johnny Johannessen, Robert Weller, Zenk and Keeley agreed to review the document. In the interest of broadening ties, OOPC agreed that Dickey should offer to attend the next COOP meeting in Cape Town in September 2002 to strengthen discussion on open ocean ecosystem and biogeochemistry issues. This would be in addition to Chairman Harrison's participation in that meeting.

3.3.2 GOOS National Commitments

Under a consultant contract from GOOS, Bert Thompson has been working to obtain and document complete descriptions of activities offered by Member States for GOOS. He is also charged with:

- reporting on the flow of marine information and on where the delivery of marine data or data products has diminished or ceased;
- identifying (in cooperation with OOPC, COOP, etc.) existing observational elements that might be appropriate for incorporation into GOOS.

Thompson summarized his findings to date. Forty Member States (of the 70 committed to GOOS) have submitted National reports during the 1999-2002 period which form the initial basis for this work. Standardized National summaries have been prepared and submitted to National GOOS Contacts for confirmation and, in most cases, further elaboration of both on-going and planned activities. (see sample in Annex IV, Part 1). These summaries along with operational data summaries issued by international information centers (e.g. JCOMMOPS), data assembly centers (e.g. GLOSS) and National data and product centers have permitted monitoring of data flow. (see examples of Drifter and Sea level Summaries in Annex IV, Parts 2 and 3). Even though this effort only began in September 2001, some trends can be seen. For example, the number of active (as of 5/29/02) surface drifters has decreased by roughly 20% since September and the percentage of drifters inserted onto the GTS has decreased to 50%. This may reflect a short-term anomaly but it needs watching. The DBCP and JCOMMOPS are looking into the GTS question. Feedback is provided to all concerned when discrepancies are found.

Initial efforts have focused on Global programs (Drifter, XBT, Sea Level, Floats and Moorings) but information on coastal and regional programs is being collected and discussed with National Contacts. Summaries which show performance over time are being prepared for each observational

component. These summaries are being used to identify negative trends which need to be taken into consideration by GOOS planning and coordination groups and supporting agencies.

Thompson indicated that it was not possible based on these early findings to make a fully supported determination on how well Nations were performing, but that he believed Member States were generally meeting their stated commitments. He noted that a major uncertainty factor is ascertaining which activities being claimed as GOOS are GOOS and which are not. Further, he stressed that commitments don't always meet requirements and that GOOS had inherited some data and data processing/management deficiencies that must be addressed.

The OOPC welcomed Thompson's effort and agreed to make available to Thompson the OOPC and GCOS National Reports. It was recommended that other reports that demonstrate how OOPC evaluates impact, be made available to Thompson, e.g., Sea Level, TAO etc.

3.4 WCRP

Following creation of JCOMM and of Ocean Basin Panels in CLIVAR, the WCRP Joint Scientific Committee (JSC) concluded that joint consideration was needed for the best way of providing oversight of global sustained ocean observations. JSC stressed that surface salinity remains an unsolved high priority measurement objective. Deep ocean observations were identified as another continuing unmet requirement.

The JSC formally recognized the outstanding contribution of outgoing OOPC Chairman Smith.

OOPC was invited by WCRP Director David Carson to participate in forming a group to identify and push for a specific set of satellite observations. Johannessen agreed to represent OOPC on such a group.

The JSC considered a recommendation for a new ?banner" for WCRP signaling a radical change from ?business as usual". The new concept would give emphasis to the predictability part (the part that some believe has been all but ignored) of WCRP's current ?prediction and predictability" charge - e.g. a Predictability Assessment of the Climate System. It would embrace, integrate and unify all WCRP major activity (CLIVAR, GEWEX, Modeling, ACSYS, etc., to reach some specific goal by 2010 that would establish the bounds of climate predictability on all time scales. If properly planned and executed, it would provide the underlying scientific and societal rationale to justify climate research and all the new satellite and other climate monitoring systems that will be needed in the future. The JSC set up a task force to develop ideas for a proposal to be aired at JSC- XXIV (March 2003). All WCRP projects were requested to discuss the ?new banner" concept and to provide views to the task force by 31 July 2002. OOPC 's position was to put strong emphasis on predictability and data assimilation as the key to good scientific governance and design.

3.5 POGO

Robert Weller reported on the 3rd meeting of POGO (Partnership for Observation of the Global Oceans) that took place at White Point in Nova Scotia, Canada on 27-29 November, 2001. He reported on the findings of the Time Series Working Group, seeking support from POGO. Dean

Roemmich, provided updates on Argo. He suggested that POGO member institutions encourage the applications of the Argo data stream, which is freely available. Roemmich underscored that this was essential to ensure the long-term viability of the programme. Prof. John Field summarized the recommendations from the POGO Biology Workshop, and Dr. Jesse Ausubel spoke of recent advances in the Census of Marine Life CoML) and its links with POGO.

JAMSTEC proposed a circumpolar cruise on their research vessel *MIRAI*, in the Southern Hemisphere, in partnership with other members of POGO. This was seen as an important step towards rectifying the imbalance in observations between the northern and southern hemispheres. The proposal was received warmly by the POGO members who had called for more southern hemisphere observations. There were also discussions on the possibility of organizing a training cruise on board a Russian research vessel, in collaboration with the IOCCG (International Ocean Color Coordinating Group).

The POGO-IOC-SCOR Fellowship Programme, which was initiated at POGO-2, is now well established. The programme receives generous financial support from IOC and SCOR. So far, 13 fellowships have been offered under this programme, which allows trainees from developing countries and economies in transition to travel to oceanographic laboratories in other countries for training on selected aspects of ocean observation. POGO also participated in, and co-sponsored, training programmes in South America (through the Austral Summer Institute organized by the University of Concepción and the Woods Hole Oceanographic Institution) and in India (in collaboration with the IOCCG). The members resolved to continue such efforts and hoped to award an additional 12 fellowships in 2003.

The establishment of a network of open-ocean, fixed-point, time-series observations received special attention and POGO supported the preparation of a time-series brochure. It did not see fit at this time to support a ?POGO Time Series Station" or to mandate incidental Argo float deployment. POGO did decide to continue its support of SEREAD (Scientific Educational Resources and Experience Associated with the Deployment of Argo drifting floats in the South Pacific Ocean).

OOPC welcomed the progress and support by POGO, particularly for time-series, outreach and capacity building. Weller believed there is still more potential for getting things done with POGO and emphasized the need to keep up the pressure. In view of the OOPC intent to take on a leading role in carbon measurements (and associated biology) we could now consider looking to POGO to assist in the ?unconventional ? aspects of the carbon network, i.e., the hydrographic program. Weller encouraged OOPC to develop some agenda items for the next POGO meeting scheduled 22-24 January 2003 in Hobart Tasmania. The chair requested members to consider recommendations for the Hobart agenda and submit them to him. The chair and Weller will sift through them and provide them to POGO in consolidated form. The chair will also follow up on the promise to supply the OceanObs99 volume to POGO.

The discussion brought to light a general point regarding the growing responsibility of OOPC to have members attend meetings of other groups (POGO, CLIVAR, COOP, JSC, etc., etc.). The sponsors will have to made aware that travel budgets for this activity should be increased accordingly.

4. ONGOING OOPC ACTIVITIES

4.1 STATUS OF TAO/TRITON AND PIRATA ARRAYS

Joel Picaut provided an update on the status of the TAO/TRITON, PIRATA and other tropical moored buoy arrays. He referred to a report prepared for the La Jolla JCOMM Workshop of 24-27 April by the Tropical Moored Buoy Implementation Panel (TIP) (see Annex V). The TAO/TRITON array in the equatorial Pacific is still the backbone of the tropical Pacific observing system. Models using data from the array suggest the development of a weak-to-moderate El Nino later this year. The focus for the coming 1-2 years is to:

- improve data return (82% in 2001);
- continue to ensure the free and wide distribution of data for research and forecasting;
- introduce new and existing technology to enhance system performance; and to
- integrate TAO/TRITON with other elements of GOOS and GCOS.

Picaut noted that moorings to extend the TAO/TRITON array into the southeastern Pacific that were implemented by Peru and Chile suffered badly from vandalism. These moorings should be replaced if the international funding is available.

In the tropical Atlantic, France, Brazil and the USA PIRATA signed a memorandum of understanding to continue the PIRATA array for a 5-year **?**Consolidation Phase" (2001-2005). Ship time for servicing the array is still an issue (servicing once per year, data return 75% during the past year). Picaut noted discussions about a Brazilian base and a dedicated vessel for routine maintenance The mooring at 0^{o} on the equator is likely to not be sustainable due to vandalism. NE equatorial, SE equatorial and W equatorial extensions are under discussion.

Picaut showed the locations of moorings already implemented (by India and Japan) or in the early planning stages in the Indian Ocean. South Africa is seeking resources for a mooring in the southwestern Indian Ocean as a contribution to the Indian ocean observing network. In general, lack of resources and the long distances involved in servicing moorings constitute a major impediment to implementation.

Edmo Campos briefed the Panel on some recommendations being discussed concerning extending PIRATA to the north and south along the Brazilian coast as part of the tropical Atlantic observing network. Annex VI illustrates proposed locations for additional moorings in the western tropical Atlantic.

Walter Zenk provided a description of the Meridional Overturning Variability Experiment (MOVE). MOVE is an observational element of CLIVAR contributed by Germany. Its aim lies both in climate and technical issues: The first aim is to start building a long time series of variations in the meridional transport of the NADA (North Atlantic Deep Water) and then to interpret it in terms of forcing of the Meridional Overturning Cell. The second aim is to demonstrate the feasibility of in-situ long-term transport monitoring using an end-point technique based on density and bottom pressure measurements. Fifty MicroCAT CTD recorders in three moorings, each covering the depth range of 1200 - 5000 m, are used to calculate the baroclinic geostrophic component of the meridional NADA transport. Barotropic fluctuations of the latter are obtained using precise bottom pressure sensors. The

moorings are located at 16ºN -- two are at the end-points of a line from 60º W to 52º W in the western North Atlantic and may be considered a northward extension of the equatorial PIRATA array. This data set is complemented by current meters, by repeat hydrographic sections along 16ºN from 60º W to 52º W and by 14 RAFOS floats. The float drift will be used to determine the current velocity at the level of reference for the geostrophic end point technique.

4.2 TROPICAL MOORING REVIEW

Smith opened a discussion of the workshop that reviewed the Tropical Moored Buoy Network (TMBN) that took place at PMEL in Seattle, 10-12 September 2001. There were no surprises emanating from the review. Though there was perhaps some slight restating of rationale and importance, the main points were still valid. The data and information contributed are not available from any other approach; the moored buoy array plays a fundamental role in the Pacific and an emerging one in the Atlantic. There is no clear scientific rationale for changing the array; diminishing resources may force change however. The buoy network supports many users and is the backbone of the tropical observing system. OOPC's position is that enhancements leading to more observations of currents, salinities, and greater vertical resolution would be valuable. Vandalism is a serious problem in the eastern and western Pacific, and in the western Atlantic. The Peru-Chile experience was discouraging in that respect. Logistics are a major impediment to implementing a TAO-TRITON type array in the Indian Ocean. Some OOPC thoughts from the discussion:

- Perhaps the rationale for an Indian Ocean array is stated too strongly.
- There is an unwillingness to consider evolution of the Pacific array.
- PMEL is unresponsive to tuning of the array to address critical scientific issues.
- Addressing vandalism by faster replacements is not enough and ultimately too high cost.
- OOPC must provide alternative strategies for resource-poor nations planning moorings.
- Small surface buoy is one approach, where winds are not crucial.
- A whole-of-tropical Pacific approach to the observing system may obviate some mooring needs.

Conclusions and Recommendations.

Re vandalism. This issue has been discussed as a technical and logistics issue many times by well informed people. OOPC can add little to the debate. We must accept that part of the PMEL role in this debate is a management issue. As managers, PMEL understandably wish to control the response to the review with regard to the TAO array (so too with those managing the TRITON moorings). On the plus side this gives them a little more return for their involvement; the downside is that it makes it difficult for the community to influence evolution. We can recommend/promote:

- alternative mooring strategies (e.g. small surface element) in difficult areas (see Annex VII);
- more emphasis on development of glider technology;
- cessation of the array elements when the data return is consistently less than 75% with a routine maintenance schedule (at this point the continuity and time-series aspects are fundamentally damaged).

Re the sampling strategy. Independent of the vandalism issue, as we move North and South away from the equator, the impact of the TMBN decreases and thus the relative priority we should attach to these moorings should be less (again, the sponsors of implementation resisted providing any such gradation). There were options discussed:

- Shift some of the resources devoted to 8°S and 8°N and (a) increase equatorial resolution; and/or (b) increase vertical sampling; and/or (c) enhance physical and non-physical measurements;
- Actively dissuade adoption of the TMBN approach outside the equatorial/tropical region.
- Implementation outside the equatorial zone should fall under the Surface Reference Network strategy, and/or the Time-Series Array, and/or a strategy for boundary currents.

Re surface observations. The review did accept that the rationale for surface obs is now moving toward the Surface Reference Network rationale and less for its direct influence on Numerical Weather Prediction (NWP) and analyses (e.g., SST). Guidance from models is crude at best. There are still some who argue that they can make "good" predictions without any input from TAO/TRITON. The reality is we will never have the number of events to "prove" that the network is mandatory, let alone the essentiality of each of the individual elements. Looking at impacts on predictability is even more elusive. The crude approach is to see where rapid air-sea interaction appears critical to understanding variability and predictability and to concentrate surface observations there.

Re Indian Ocean. Based on present knowledge, there is general agreement that the most critical scientific aspects are those for which rapid air-sea interaction is important. The case for data for Intercomparison Projects is less prominent, though it would be premature to rule this out as a factor. It is also clear that limited availability of resources will dictate that a tropical moored array in the Indian Ocean is almost not sustainable and we need to apply other strategies.

Smith opined that the review did not suffer from lack of input on any particular issue. It suffered because it failed to take the chance to provide guidance for evolution of the system. He recalled that as we move from a purely experimental to a sustained network (as in the four stage approach) it should be more difficult to adjust and make *ad hoc* changes. Thus, in the context of the above discussions, the core subsurface and surface reference aspects of the networks (mainly Pacific at present) should only be changed if there is unambiguous evidence for such change. Elements that fall outside this part should be considered as discussed above. Smith concluded that he believes OOPC has a solid strategy and that operational implementation is being undertaken within a framework that is robust, though perhaps the ability to develop capacity has not been linked strongly enough to this strategy. The report of the Workshop is being prepared by Piers Chapman at Texas A&M University.

4.3 AIR-SEA FLUXES

Peter Taylor summarized the work of the JSC/SCOR Working Group on Air-Sea Fluxes (WGASF). The WG produced a comprehensive assessment of the state of the art regarding air-sea flux determination (published in the WCRP report series, WCRP-112, Intercomparison and Validation of Ocean-Atmosphere energy Flux fields, November 2000 and also available at http://www.soc.soton.ac.uk/JRD/MET/WGASF/). Subsequently, the WGASF organized a workshop (Washington, DC, May 2001) bringing together the different scientific communities interested in air-sea

fluxes to review the Working Group Report and to consider what needed to be done to determine surface fluxes more accurately. The workshop was considered a success with well over a 100 participants from 15 countries. A summary of the Workshop is in Annex VIII.

The WGASF (which was established as a limited-life group) formally came to the end of its mandate following the Washington workshop. Besides providing a comprehensive overview of the flux field problem and a first attempt to evaluate existing flux fields, its work has identified gaps in our knowledge about the sea-air fluxes. Particular problems are the lack of closure for global and regional-scale energy balances, and the large regional biases in flux components. Our knowledge is deficient regarding the seasonal and interannual variability of sea-air fluxes, and also with regard to the error characteristics inherent in the flux products.

In view of the number of outstanding questions relating to physical air-sea interactions in the WCRP and follow-up required to the work of WGASF, the JSC had already recognized at its twenty-second session (Boulder, March 2001) that a new WCRP "air-sea interactions" group would need to be established. Such a Working Group should provide a long-term comprehensive assessment of the air-sea interaction problems in different WCRP research programmes. Taking into account the issues identified by the JSC, and recommendations arising from the WGASF workshop, the following terms of reference were proposed for the new group:

1. Review the requirements of the different WCRP programmes with regard to the air-sea fluxes.
2. Facilitate communication and coordination between the various research initiatives on air-sea fluxes.
3. Encourage research and operational activities aimed at improving our knowledge of the air-sea fluxes.
4. Keep the scientific community and the JSC informed of progress achieved, through regular reports, the World Wide Web, and, as necessary, scientific workshops.

The JSC had nominated Peter Taylor as the Chairman-designate of the new group. However, before the twenty-third session of the JSC Taylor was forced to resign this position for personal reasons. The decision of the JSC was to designate matters concerning the formation of the new group to the WCRP Officers and Secretariat. It was suggested that they should consider the possible role of the air-sea interactions group in relation to the Surface Ocean-Lower Atmosphere Study (SOLAS). In this respect, it was noted that SCOR has raised the issue of continuing collaboration between WCRP/SCOR in the area of air-sea fluxes and related topics, expressing a wish that this be through co-operation in SOLAS, particularly through SOLAS Focus (ii). It was also considered important that there be coordination with the GEWEX sponsored SEAFLUX project.

Taylor noted that it may be of some concern to OOPC that the important issue of surface fluxes has now lacked a focus within the WCRP for a period of a year or more and the OOPC might wish to consider whether some action should be taken. He believed we still need a formal WCRP WG to keep communications between WCRP, SOLAS, etc. but that experiments can be done apart from the formal WG by *ad hoc* groups.

OOPC concluded that a letter would be sent by the chair to the JSC and CLIVAR SSG chairs that:

- emphasizes the fundamental importance of the Air-sea flux activities to OOPC and GODAE as well as projects like SURFA;
- conveys our support for the WG explicitly being associated with SOLAS, but that underscores such a WG has a raison d'etre independent of that association;
- states that in light of the CLIVAR SSG recommendation to form an *ad hoc* WGASF, OOPC would support the immediate establishment of a technical WG; and
- recommends P. K. Taylor be considered as an OOPC representative member for that WG.

It was agreed that Weller could enlarge on the rationale for OOPC's position in communicating this decision to CLIVAR It was further agreed that OOPC will form a group to look after experiments.

4.4 VOS CLIMATE PROJECT

The objective of the VOS subset envisaged by the VOS Climate project (VOSClim) is to provide a source of high-quality marine meteorological data and associated metadata, suitable for a number of applications, including global climate monitoring, research and prediction. The data from VOSClim lines are seen as potential future reference data sets, integrated where possible with upper atmospheric and subsurface lines. The third project meeting (VOSClim-III) was held in Southampton, U.K. in January 2002.

A target of 200 ships to initially participate in the project has been established and a number of countries, including Australia, Canada, France, Germany, India, Japan, Poland, United Kingdom and USA, have already started the recruitment. Participating ships are requested to report a number of additional observational elements, which are essential to the success of the project. However, because of the CBS goal of converting all the alphanumeric codes to table-driven codes (i.e. CREX, BUFR, and GRIB), it has been decided that the existing (unmodified) ship code will have to be retained for real time reports and that the additional observation information will only be provided in delayed mode, in the modified IMMT-2 code format. The additional information will therefore be recorded in ships' hard copy or electronic logbooks for future collection, processing, archival and delivery to users.

Participating ships are also requested to provide additional metadata, in accordance with the revised contents of the WMO ship catalogue (WMO-No.47). For the purpose of collection of these metadata, a dedicated recruitment/inspection form has been developed for the project. The Ship Operations Team meeting (SOT-1) suggested that this form and accompanying instructions be made available to all VOS operators, and also be included in WMO guidance material for Port Meteorological Officers. VOS operators are encouraged to use the form to collect the metadata to be submitted to the WMO ship catalogue. SOT-1 also suggested a continuing review of the metadata needed for VOS, SOOP and ASAP vessels with a view to a possible extension of the survey form in future to all SOT vessels.

A Real Time Monitoring Centre (RTMC, located at the Met Office, U.K.) and a Data Assembly Center (DAC, located at NCDC/NOAA, USA) have been established for the VOSClim project. The project brochure has been published in three languages and distributed to participants. A project newsletter has also been designed and the first issue is planned to be published in September. A project web-site has been set up by the DAC and is beginning to be populated with information.

During the discussion at SOT-1 of the observational elements to be reported by ships, the meeting realized that original wind speed and direction were often reported, without height correction applied. However at the present time, WMO technical guidance suggests that wind reduced to 10 meters should be reported and such is the case with, for example, the TURBOWIN software. Unfortunately, whether a particular vessel reports the original observation or height corrected wind value cannot be detected in the current format. SOT-1 suggested that the original purpose for reporting the reduced (10m) wind speed was no longer essential for operational meteorology and that it was much more valuable scientifically (e.g. for climate studies) if the original wind data were reported. The meeting therefore requested that a recommendation to this effect be submitted for consideration at JCOMM-II, through the Observations Coordination Group and the Management Committee. Information on whether the reported value is the original wind or the reduced value will be indispensable, especially during the (considerable) transition period. The VOS Panel chair and the VOSClim leader were requested to develop a procedure for obtaining this information in the short term.

OOPC welcomed the continuing progress of the VOSClim project although perhaps inevitably, at a slower rate than originally envisaged. OOPC agreed with Taylor that the project needs continuing strong advocacy. Key groups need to voice their support of VOSClim, this is an important thing to do. The chair agreed to take steps to remind JCOMM and other meteorological groups of how important the Project is, that we support 200 ships as part of a high quality surface meteorology, and that we look forward to extending VOSClim beyond 200 ships. OOPC agreed to work with the project to identify priority areas and lines where implementation is critical. The point also needs to made that there is a lot of work for the Port Meteorological Officers (PMOs) and the countries need to provide adequate resources for the PMOs. It was also suggested that met buoys could be part of VOSClim in a high quality network for surface meteorological observations.

4.5 OBSERVING SYSTEM SENSITIVITY EXPERIMENTS (OSSES).

Smith informed the Panel that Ants Leetmaa, Director GFDL, is sympathetic to more sensitivity experiments at GFDL in connection with other ongoing efforts there. The Panel agreed advantage should be taken of this opportunity. One possibility would be to organize a workshop focused on determining whether models can provide useful guidance on observing strategies based on observation system experiments. It was agreed that a few Panel members should start thinking about an agenda that could be melded into the reanalysis workshop being planned by CLIVAR (see section 6.3.1), and backed by OOPC, that might provide a set of such experiments. Harrison, Michida and Reynolds were named as OOPC point men for exploring this further with CLIVAR and Leetmaa. US NOPPS will soon announce an opportunity for funds for this kind of activity. Smith proposed that OOPC should take the responsibility for the OOS part of a joint CLIVAR reanalysis workshop.

4.6 OCEAN CLIMATE INDICES.

This subject was introduced at OOPC-VI (See sec 5.7 of OOPC-VI Report). Each Panel member was tasked with providing Harrison during the ensuing intersessional period with a list of three important indices. They were to be chosen on the basis of having potential relevance to assessing the ocean state, or the state of the observing system, or the effectiveness of a publicity campaign. The was to be a first step in a process that would lead to the development of a set of ocean state indices which would become part of an annual state-of-the-ocean report to WMO, IOC, and the UNFCCC.

The effort to assemble the list was begun but without much vigor due to other priorities. Harrison reported to the Panel that the listing process was still going on. He showed the current list including SST, Sea Level, Thermocline Depth, Deep/Bottom Water Properties, Transport, Ice, and others. Some suggestions were raised by members to add a couple of indices for biodiversity, meridional overturning, and water quality. Alexiou, at the same time, pointed that the indices should be those that can be obtained with simple observations. Harrison stated the necessity to specify the frequency and/or accuracy of repeat hydrographic sections, for example, for nominating as an observation of climate indices. The chair requested that this effort be advanced between now and OOPC-VIII. Harrison and Reynolds were charged with continuing the development of this concept including an outline for a strawman state-of-the-ocean report based on the indices.

Alexiou mentioned a related German project called GEOSCOPE, an effort to design a global monitoring system which combines remote sensing with on-the-ground information to monitor the interaction between man and nature in the earth system. The aim is develop a limited set of about 30 easily monitored integrating variables that represent indices of sustainability of human practices in collision with the natural system.

4.7 SST/SEA-ICE WORKING GROUP

Richard Reynolds reported on the working group's (WG) progress regarding the recommendations from OOPC-VI. These recommendations are listed below in italics, each followed by a discussion on the progress.

1. Investigate the quality control (QC) and analysis procedures to determine why the SST analyses differ.

Reynolds and several others of the WG attended the Workshop on Advances in the Use of Historical Marine Data (Boulder, Colorado, January 2002). At this meeting a comparison project was agreed upon. For this project, a common in-situ input data set will be used and in-situ SST analyses from these data should be computed and compared. Three agencies (JMA, UK Met Office and NOAA/NCDC) agreed to participate in this plan.

2. Examine the accuracy of sea ice fields and sea-ice-to-SST conversion algorithms.

This work has been difficult to carry out because the WG has limited experience in working with sea ice data linked to SST analyses. However, this problem was discussed at the Workshop on Advances in the Use of Historical Marine Data and at a meeting of the Arctic Climate System (ACSYS) Study and the Climate and Cryosphere (CliC) Project (Toulouse France, April 2002). Nick Rayner of the UK Met Office and a member of the WG, attended both meetings. One of the most important contacts made was Vasily Smolyanitsky of the Russian Arctic and Antarctic Research Institute, who Chairs the WMO/IOC JCOMM Expert Team on Sea Ice. He has agreed to provide help on the blending of sea ice data. In addition, the ACSYS/CliC Workshop agreed that there was a need for all historical sea ice data to be available at one location in one electronic format and that all historic sea ice data sets should be identified and made available there. Rayner has worked on sea ice fields and sea-ice-to-SST conversion algorithms and she has agreed to take the lead on this project for the WG.

3. Maintain a link with the GODAE High-Resolution SST project.

Rayner attended the 2nd International GODAE High Resolution Workshop (Tokyo, Japan, May 2002) to represent the WG. In her presentation she defined the goals of the WG, commented on the GODAE High-Resolution SST Pilot Project (GHRSST-PP) plans from a climate perspective and asked for suggestions on how the SST WG could help the GHRSST-PP.

4. It would be useful to have IR satellite retrievals that include cloud contamination estimates.

At both the Workshop on Advances in the Use of Historical Marine Data and the GHRSST Workshop it was recommended that flags should be used to indicate the likelihood of cloud contamination and the associated negative SST biases.

5. Complete development of an SST web server to allow users to examine differences in SST.

This server is almost complete and is available at: http://ferret.wrc.noaa.gov/reynolds. It is planned to move the server to the National Climatic Data Center (NCDC) by September 30, 2002. At present there are two problems. The first is that the British Met Office SST fields are proprietary and have restricted access. These fields can be plotted but cannot be downloaded. The second is that much of the SST documentation has not been received. Reynolds promised to work on these problems.

6. Develop an interface between SST data users and SST data providers to indicate where future buoy deployments are needed.

Reynolds and Huai-Min Zhang (NCDC) have made progress on this item. They developed an SST "Buoy Need Index (BNI)" to show regions where in situ SST data are needed and where new buoys should be deployed. This work is an effort to go beyond the preliminary work done for the OceanObs99 Conference and reported in Reynolds, R.W., D.E. Harrison and D.C. Stokes, 2001: Specific contributions to the observing system, sea surface temperatures, 87-101, in: Observing the Ocean in the 21st Century, C. J. Koblinsky and N. R. Smith (editors), Bureau of Meteorology, Melbourne, Australia.

To objectively determine the BNI, the NOAA optimum interpolation (OI) SST analysis was used with monthly data from 1990 to 2001. In this presentation, two data requirements were identified for in situ SSTs:

- to produce analyzed SSTs in regions without adequate satellite retrievals, and
- to correct biases in satellite retrievals.

It is assumed that a higher density of in situ data is needed in regions without satellite data. Because there are two requirements for in situ data, two OI error estimates were made, one using in situ data only and one using satellite data only. The range of the OI normalized error is 0 to 1 where 0 indicates perfect data and 1 indicates no data. The OI error estimate was used to define the BNI. For in situ data, the error was divided into 3 coverage categories (good, fair and poor).

For satellite data only two categories (good and poor) were needed. The SST BNI is determined from the 3 categories of in situ data and the 2 categories of satellite data as shown in the figure. For BNI =

0, additional buoys are not needed; for BNI = 1, buoys are needed for satellite bias correction; and for BNI = 2, buoys are needed to define SST directly.

Further improvements in the SST BNI are needed. It is planned to compute the OI error with simulated buoys at different densities so that the BNI can be objectively defined to define a required buoy density. Reynolds plans to circulate a copy of this presentation to the WG and others for comments. A final product will be produced in real-time on a regular basis.

It was noted the SST BNI was useful but needed more work. In particular it was recommended that OI error correlation scales be reexamined and the analysis temporal resolution be changed from monthly to weekly analysis periods.

The discussion produced several additional recommendations and comments. It was recommended that:

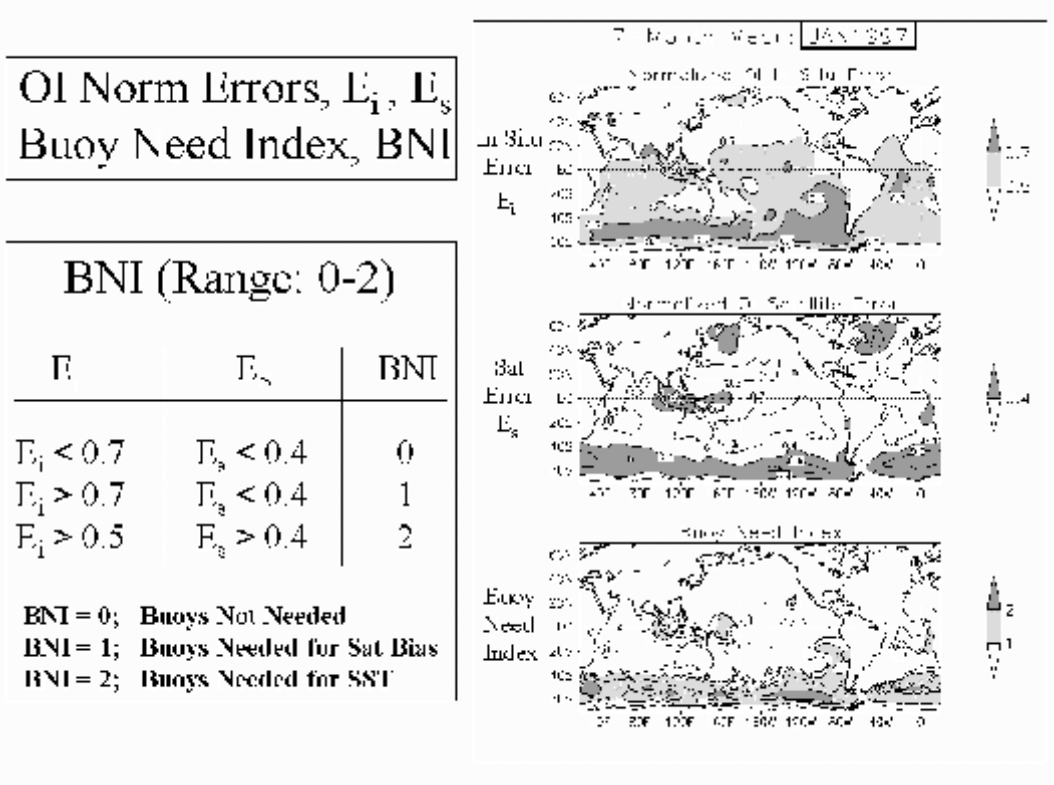
1. continued QC and analysis comparisons be carried out;

2. links be developed with EUMETSAT Ocean and Sea Ice Satellite Application Facility (Pierre Le Borgne, Meteo-France);

3. the SSTs from temperature profile data (XBT, Argo, etc.) be used to determine the impact of these data on SST analysis;

4. Vasily Smolyanitsky and/or Nick Rayner attend OOPC-VIII.

The Panel emphasized the importance of Rayner's liaison with GODAE High-Resolution SST project. Her work on the sea ice fields and contacts with other sea-ice scientists was also recognized to be of high importance to the SST WG. (For more on sea ice, see section 8).



The figure shows the OI in situ and satellite error in the upper and middle panels and the **?**Buoy Need Index in the lower panel The range is between 0 and 2. For BNI = 0, additional buoys are not needed; for BNI = 1, buoys are needed for satellite bias correction; and for BNI =2, buoys are needed to define SST directly. To smooth the individual monthly noise, all values are averaged over 7 months centered on January 1997. Because the Buoy Need Index is an average, it no longer has to have an integer value. The index shows that buoys are most needed in southern high latitudes south of 40°S. However, there are other regions that also indicate a need for buoy data, e.g., the tropical western Pacific and eastern Indian Oceans where satellite data are sparse.

4.8 SURFA

Weller reported that the SURFA (Surface Reference Sites) project had been essentially on hold and now may be ready to move ahead. (See OOPC-VI Report, section 6.3 for the intended effort). The problem was that the US Department of Energy (DoE) suffered budget cuts that impacted Peter Glecker's ability to devote effort to the project last year. His role was key to obtaining the high quality observations for the CMIP (Coupled Model Intercomparison Project) that are necessary to help pin down sources for differences between NCEP and ECMWF analyses. The reason for moving ahead is still strong and we need to reinforce to WGNE (Working Group on Numerical Experimentation) that SURFA is important. Weller reported that the WHOI test of the Triton-TAO at moored sites produced good comparisons.

It was unfortunate to learn how sensitive we are to specific agencies (in this case DoE). CMIP is one of several projects under the Program for Climate Model Diagnosis and Intercomparison (PCMDI). It is funded by the Environmental Science Division of the U.S. Department of Energy's Office of Biological and Environmental Research (BER) as part of its Global Change Research Program. Its mission is to develop improved methods and tools for the diagnosis, validation, and

intercomparison of global climate models, and to conduct research on a variety of problems in climate modeling and analysis. One option might be to have PCMDI to serve more as a clearing house and thus lessen the dependence on single individual.

In accordance with Weller's suggestion, the Panel agreed that the chair should write a letter to Kamel Puri, Chair of WGNE, emphasizing OOPC's continued high interest but recognizing it has been difficult to maintain momentum under the circumstances.

4.9 TIME-SERIES STATIONS

Weller informed the panel of his efforts to position time series stations in locations that optimize observational needs and resources of as many partners as possible. He has been working with DEOS, a program for study of the Dynamics of Earth and Ocean Systems which has attractive potential as a partner for implementing time series stations. DEOS (formerly known as Deep Earth Observatories on the Seafloor) is looking for plate-scale process studies and has developed a strategy involving continued support of long-term autonomous instrumentation and emphasizing pursuit of two newer and technologically-distinct approaches to implement a national seafloor observatory capability: One of these involves moored buoyed observatories providing power to seafloor instruments and a satellite communication link to land. These would require regular servicing and could include permanent deployments for experiments in remote locations, or long-term physical oceanographic experiments.

A brochure, a **?**white paper" and a web site are being developed to promote the time series program. Weller stressed that we still need strong scientific support for physical/dynamic sites that provide a rationale for sustained specific sites. We need to understand mesoscale statistics. OOPC agreed Weller and his associates are making very good progress.

4.10 OCEAN CARBON

4.10.1 Ocean Carbon Observations

Smith brought the Panel's attention to the GOOS Report No 118 titled: A Global Ocean Carbon Observation System – A Background Report. It is on the web at:

http://www.bom.gov.au/OOPC/OOPC_VII/OceanCarbonObsrFINAL1.htm.

The report was written and compiled by Scott Doney (WHOI) and Maria Hood (UNESCO-IOC), with contributions from J. Bishop, H. Ducklow, R. Fine, N. Gruber, R. Jahnke, K. Johnson, E.Lindstrom, K.K. Liu, F. Mackenzie, C. McClain, P. Murphy, T. Platt, S. Smith, V. Stuart, B.Tilbrook, D. Wallace, and R. Wanninkhof. Smith saw the observations issues in the report of ecosystems and biogeochem in the open ocean as being the part for which COOP would take the lead, with OOPC taking the lead on the issues concerning the carbon cycle. Smith believed we should press forward with the carbon part; the "plan" in the report can be a template for OOPC. This would be the strategy against which OOPC could progress implementation. We would ask Maria Hood to develop an "account" of implementation progress while we wait for more formal mechanisms to emerge.

There are some aspects for which we need a different implementation mechanism. Just as we have looked to POGO to take a lead role with the time-series observations, we should challenge POGO's ability to take on the carbon and other non-physical observations. Smith opened a discussion

on structuring a pilot project to move things forward. A first step might be the preparation of a short paper that identifies those elements of the ecosystem that we could include in the pilot project. The Panel agreed that Dickey (in partnership with the SCOR IOC Ocean CO_2 Panel) should move this idea forward by enlisting assistance from COOP (John Cullen, John Field, and Julie Hall were proposed as potential names), some persons from research to draft a preliminary equivalent of the ocean carbon report but focused on ocean carbon aspects. The Panel agreed on other attributes for the report. It should:

- be focused on robust, sustained observations;
- clearly identify the rationale for GOOS doing it; and
- include a discussion of the instruments and the technology.

Dickey voiced his concern about leaving the open ocean ecosystem/biogeochemistry to COOP based on what he suspects is a too narrow COOP focus on coastal measurements. Some of these observation matters were taken up again during discussion accompanying the science lecture by Douglas Wallace (see Sec 9.).

4.10.2 Ocean Biochemistry Programs

Dickey reviewed several of the international biochemistry programs that are currently active and related to the ocean carbon issue.

SOLAS (Surface Ocean - Lower Atmosphere Study) is the new IGBP international research initiative which has as its goal: ?To achieve quantitative understanding of the key biogeochemical-physical interactions and feedbacks between the ocean and the atmosphere, and how this coupled system affects and is affected by climate and environmental change". SOLAS is moving forward with its planning. The final draft of the Science Plan is expected to be completed within a month or so. Over the following 6 months this Science Plan will be converted into the Science Plan and Implementation Strategy for SOLAS. Thus, unlike most previous IGBP projects, which published a Science Plan followed by a separate Implementation Plan, SOLAS, as the first new project in IGBP-II, will ultimately have a fully integrated Science Plan and Implementation Strategy. Dickey noted that the EC is showing interest in this program.

JGOFS (Joint Global Ocean Flux Study) is planning an Open Science Conference: ?A Sea of Change" to review the JGOFS accomplishments and the future of ocean biogeochemistry. It will be held 5-8 May 2003, at the US National Academy of Sciences.

Dickey informed the Panel that a workshop would be convened on real-time coastal observing systems for ecosystem dynamics and harmful algal blooms" on 11-21 June 2003 at the Observatoire Océanologique and Citadelle of Villefranche-sur-Mer, France. The idea of this workshop was initially recommended by the Working Group on Harmful Algal Blooms Dynamics of ICES (International Council for the Exploration of the Sea); the plan is supported by GEOHAB (Global Ecology and Oceanography of Harmful Algal Blooms; IOC and SCOR), and the Coastal Ocean Observations Panel (COOP) of GOOS.

The LOICZ/JGOFS Continental Margin Task Team (CMTT) will hold a workshop for the Global Synthesis of the 5 Regional Syntheses 4-6 December 2002 in Washington DC. The CMTT was charged with assessing the fluxes of major biogenic elements in continental margins relevant to climate change. The product of the assessment will be a synthesis book supported by IGBP. The CMTT has divided the task up into 5 regional sub-groups: eastern and western boundary systems, polar margins, tropical margins and marginal seas.

Dickey reported there is a new follow-on program in the talking stage on ocean ecology and ocean biogeochemistry. He sees this as a development to pick up the parts of JGOFS and GLOBEC (GLOBal ocean ECosystems dynamics) that SOLAS does not.

5. REGIONAL ACTIVITIES

5.1 INDIAN OCEAN MAURITIUS CONFERENCE

Smith reported on the planning of the Indian Ocean Global Ocean Observing System (IOGOOS) Conference scheduled for 1-9 Nov 2002 in Mauritius. William Erb, is organizing this out of his IOC-Western Australia Regional Office in Perth. He is working with countries in the region that are moving toward forming some kind of GOOS Indian Ocean consortium. About 100 persons are expected to attend. The agenda is broader than climate and covers coastal as well oceanic issues.

Gary Meyers is organizing the ocean and climate workshop part that is the most important part for OOPC. It includes scientific rationale, moorings, Argo floats, integrated obs system, links to coasts and ecosystems, data management and implementation planning. Presentations are planned on remote sensing, ocean prediction, climate prediction, and intra-seasonal predictions. OOPC members are invited to contribute to papers being organized by lead authors who will be giving the invited papers

Tom Malone, Co-chair of COOP is organizing the coastal workshop counterpart. Peter Pissierssens of IOC and Merv Lynch, Professor Curtin University, will conduct seminars on IODE data management and satellite applications respectively.

Discussion revealed some uneasiness with the agenda design and the length of the Conference. The provisional scheduling of workshop sessions tends to interrupt continuity and needlessly spread them over a longer time than seems necessary making it harder to sustain interest. It was concluded that in addition to looking at regional processes, the workshop could benefit by taking a larger perspective for the Indian Ocean observing system, i.e., a realistically achievable, basin-wide system composed of a combination of moorings, floats, XBT lines, etc. At present, given the limited resources available and the difficult logistics for maintaining it, a TAO-type, full-mooring array is not feasible for the foreseeable future. These comments would be provided to the organizers by Smith

Several weeks after OOPC-7, a second announcement for IOGOOS was issued with an adjusted agenda. It took account of many of the points identified above. The Conference dates were changed to 4-9 November and the agenda was adjusted to avoid the workshop interruptions in the original scheduling. The announcement also contained updating information. About 200 scientists and high level officials representing Indian Ocean Rim

countries and other countries outside the region with an interest in the Indian Ocean, as well as representatives of regional and international ocean bodies and programmes are expected for the meeting. One of the highlights will be the signing of a Memorandum of Understanding (MoU) by members, on an agreement to formally establish an IOGOOS Regional Alliance to foster co-operation towards the development and strengthening of operational oceanography in the Indian Ocean. It is expected, therefore, that the head of delegation of participating institutions and agencies will come prepared to endorse the MoU, a draft of which is currently being circulated to all those concerned for comments.

5.2 SOUTH ATLANTIC OCEAN WORKSHOP

Edmo Campos briefed the Panel on progress with the planning of the OOPC-CLIVAR South Atlantic Workshop. The original hoped-for timing for fall of 2002 was now unrealistic and a new planning goal was for a workshop in early 2003 in either Rio or Sao Paulo. Campos distributed a rough draft of the latest Workshop plans that addressed the scientific background, motivation, structure, goals, proposed titles and outlines for invited discussion papers with suggestions for lead authors. The draft document is in Annex IX.

Walter Zenk presented as additional background, a description of intermediate water flows and mixing processes in the South Atlantic subtropical gyre. He referred to KAPEX (Cape of Good Hope Experiments), an oceanographic research project, which focuses on the spreading and inter-ocean exchange of subsurface water around southern Africa. The KAPEX website provides a detailed description with charts <http://www.ifm.uni-kiel.de/fb/fb1/po2/research/woce/kapex/>. There is some leakage of Indian Ocean water at the intermediate level but there is no continuous path of the Agulhas into the Benguela in the South Atlantic at that level. WOCE had heavy sampling at this level on the western side near Brazil. The analysis indicates that there is some leakage out of the South Atlantic at that level along Brazil to the North.

The Panel offered a number of comments and suggestions. Atmospheric obs are needed; these are not present in the draft and are needed for climate studies. There is a need to play up the attraction of GOOS locally to enhance support. There is recognized attraction to GOOS on the eastern side of the South Atlantic. The local scientific importance on the western side is the bifurcation of the South Equatorial Current and the Brazil/Malvinas Confluence. The met services, the navies, and the oil and gas services would seem to have the strongest interests in a GOOS type workshop, less in a CLIVAR type climate workshop. The case needs to be made, however, that the South Atlantic has impact larger than just the local effects in order to attract larger funding. The discussion paper outlines seem to be about right, but something on remote sensing would be useful; Johannessen offered to help here. Commercial Applications could be a stand alone Discussion Paper, separate from the one on Applications and Services Opportunities.

OOPC expressed concern that the time and place for the workshop were still in doubt and wished to see rapid resolution of this matter. Other specific points were offered as guidance. More representation is needed from South Africa; Chris Thorncroft might be pinged on for this. The organizers should seek assistance from POGO who have been asked to help as well. The workshop should seek to have about 30-35 participants. Additional people should be identified to assist with the lead authors in developing the Discussion Papers. The Organizing Committee should try to have

balanced representativeness of the interests of both the east and west sides of the Atlantic and of both research and operational applications. Any imbalance between CLIVAR and OOPC/GOOS interests in the programming and desired outcomes of the workshop should tilt on the OOPC/GOOS side.

6. EXPERIMENTS PROGRAMS AND PROJECTS

6.1 GODAE

Smith provide an overview of GODAE activities. The International GODAE Steering Team (IGST) met in December 2001 and good progress was evident on most fronts. Prototype products are available from several groups (see URLs below). The draft implementation is under review with publication due later this month; OOPC will help in the review. The GODAE Symposium in Biarritz is scheduled for 13-15 June 2002 - the week right after OOPC-VII. Some 102 papers have been accepted with 24 invited presentations ranging from the concept through scientific and technical development, to applications. Key URLs are:

· Strategic Plan: http://www.bom.gov.au/GODAE/Strategic_Plan.pdf
· High-Resolution SST Pilot Project: http://www.bom.gov.au/GODAE/HiResSST/
· GODAE Symposium: http://www.cnes.fr/BIARRITZ2002
· Prototype products and URLs: http://www.bom.gov.au/GODAE/godae_product_urls.htm

An international Workshop on GODAE in the Pacific Ocean was held at the IPRC, Hawaii, during July 2001. Several areas came into focus:

- Intercomparison Projects in each ocean basin
- The need to improve model and assimilation parameterizations.
- Quality control in operational systems tested in GODAE model systems.
- Test the need for a real-time ocean current data/product facility. (IGST developed prospectus)
- Need to develop stronger links with the user community.
- Need exists for short term deliverables (Indian and South Atlantic Workshops take note).
- The need for improved data and product serving (Workshop at Biarritz to address).
- The need for further studies of predictability, particularly for mesoscale and coastal (boundary condition) forecasts. GODAE would welcome comment from GOOS COOP in this area.

The IGST endorsed intercomparison Projects in the North Atlantic (LeProvost - CNES to lead), the North Pacific (Kamachi - MRI and Mitsudera - IPRC to lead) and the Tropics (Rienecker -GSFC to lead, discussions are underway with WGSIP). The IGST also agreed to initiate a model and data assimilation Quality Control monitoring and evaluation project. Cummings (FNMOC) has agreed to lead the QC project.

6.2 ARGO

Smith began a brief update of Argo progress by noting that Norway had joined the Argo ?club"with 3 floats committed and a proposal for 50 more. The fourth meeting of the Argo Science

Team (AST-4) was held in Hobart, Tasmania, Australia, from March 12-14, 2002. International commitments to the Argo project continue to increase. More than 10% of Argo has now been deployed. For the number of floats actually deployed and their positions see the Argo web site at: http://w3.jcommops.org/website/ArgoMap. Matters that were addressed included final steps to complete the data management system, technical aspects of float performance, regional float deployment planning mechanisms, and the need for rapid utilization of Argo data. Another objective of the meeting was to encourage float-providing nations to increase deployments in the Southern Hemisphere - and to that end a Southern Ocean Science Symposium was held in joint session with the CLIVAR Southern Ocean Panel.

A second meeting of the Argo Data Management Team was held in Brest in October 2001. Formats for exchange of Argo data have been agreed, and direct exchange of data between national and global data centers (GDACs) will occur soon. The AST meeting in Hobart requested the data system to strive to start exchange of the scientifically reviewed Argo data by September, 2002. According to Keeley, Argo now receives 1300 T/S profiles down to 2000 m each month with 50% availability within 24 hours. Keeley described the flow of data from the float through the various communication links and data centers to the end users and underscored the role of the P.I. in quality control in the circuit, particularly for calibration. He noted that the Argo Monterrey server (not the GODAE server) is a Brest mirror and that non-standard Argo floats need meta data. At present, Argo profiles are published on the GTS and distributed via the Internet by the IFREMER/Coriolis GDAC. For more detail on Argo DM see Annex X.

Technical issues relevant to Argo were reviewed. A major development is the availability later this year of the Iridium system for communications bandwidth, two way capability and decreased surface time for Argo floats. More successes with stable salinity sensors were reported. Several technical problems (and solutions in some cases) were described by individual groups - including surface pressure drifts, rapid battery drain due to a controller failure, and salinity offsets in some recently deployed floats. It was noted that the Argo technical forum has not been a useful mechanism for information exchange and a technical workshop should be staged at an appropriate time.

A formal mechanism has been established for iteration and web publication of regional plans for float deployment. For each ocean basin a deployment coordinator is identified as well as points of contact for all float-deploying groups. After communication with the float providers, the coordinator will publish plans extending approximately 12 months in advance, and these plans will be updated at least every 6 months. A number of other issues related to large-scale implementation of Argo were discussed. Possible activities and participants for the regional data centers were identified. A mini-symposium was held describing early scientific results from Argo data and it was agreed to emphasize Argo results in future meetings. The next meeting, AST-5, will be held in Hangzhou, China around March 2003.

OOPC agreed Argo should provide a good demonstration of how data leads to useful products. Looking ahead, this Argo DM system offers an opportunity to demonstrate its usefulness for all T and S data.

Steve Piotrowicz informed the Panel that development of Sea Glider is still progressing. He stated that a recent 1-month field test had completed 370 dives, a number to 1000 meters.

Regarding Iridium, Piotrowicz noted that the military and commercial customers are using the system mostly for data transmission. Current cost is about $1.00 - $1.50 per minute. The US Department of Defense has contracted to pay 40% of Iridium Satellite LLC operational costs. The satellites should last till 2010. Tests to reduce costs still further are in the offing by "short burst messaging" i.e., doing communications while verification is underway.

Piotrowicz believed that the Argo program should adopt a real-time, two-way telemetry system (ORBCOMM, Iridium, Teledesic if it ever is launched) and one that permits much higher effective data transfer rates than are currently available. He noted that JCOMM are lookiing to real-time, two-way telemetry for observing systems that are under development today.

6.3 CLIVAR

Jurgen Willebrand briefed OOPC on discussions at the recent CLIVAR SSG on the future of the CLIVAR Ocean Observations Panel (OOP). He noted that the creation of the Basin Panels (Atlantic – Visbeck; Pacific – Richards; Southern Ocean – Rintoul; AAA Monsoon – Webster, Slingo) had changed the requirements of CLIVAR for implementation oversight.

The SSG suggested that a member from each CLIVAR Ocean Basin group should be an ex-officio member of the OOPC. There may be some need to adapt the Terms of Reference (ToR) of the OOPC (liaison role) but we would hope that no other changes would be required. Basically the OOPC will continue to provide scientific guidance for sustained observations. In the context of GOOS/GCOS strategy of the Nowlin et al. “4 stages of development” [(1) pure experimental; (2) experimental observing network; (3) pilot sustained network; and (4) a sustained network], this means OOPC will take more direct interest in experimental pilot projects (stage 2), particularly those with global relevance, and their transition to stage 3 (GOOS/JCOMM Pilot Projects such as Argo, PIRATA). The Secretariats will examine these ToR issues and aim for having any needed modifications completed by. Modifications to the OOPC ToR, must be approved by GOOS and GCOS.

The OOPC could find no major issue with such arrangements. Its preference was for minimal change in its ToR. Basically the OOPC will continue to provide scientific guidance for sustained observations. Interaction with the basin panels will be a key issue. For the Pacific and Southern Ocean this should be OK but more competing views may arise for the Atlantic where several “stage 2” components are being tested (e.g., the PIRATA extensions). The OOPC noted that the new group will more closely align with the work program of GODAE particularly with respect to interests in ocean state estimation. However, in view of GODAE’s need for strong research partners, particularly post-2005, this change of strategy should overall strengthen the effort. Indeed, at the longer time scales, such an effort within CLIVAR would provide greater motivation for investment in the research.

6.3.1 Reanalysis Workshop

Under the new CLIVAR oversight structure, the SSG concluded that CLIVAR OOP should be replaced by an activity that was more focused on analysis, diagnostics, assimilation and re-analysis. The CLIVAR OOP would continue to exist but its remaining task would be to plan a workshop that was dedicated to these issues (see also sec 4.5 on OSSEs). The OOPC noted that the reanalysis workshop being planned should also be put on the agenda for GODAE and OOPC to make sure that

the intersection lines are properly highlighted and addressed. The post GODAE outlook would also be an issue to discuss in this context. (See also sec 4.5 on OSSEs). OOPC agreed to co-sponsor the workshop.

6.3.2 Data Management Issues

Weller noted that data management issues were also discussed at the CLIVAR SSG. It was decided that WOCE data centers (DACs) will be retained for another three years under CLIVAR. Its data management issues should be relevant for OOPC. OOPC are concerned with data quality, data merging, continuous and homogeneous data, data archiving, product quality control and data system allowing real time access.

OOPC with partners (JCOMM and IODE) will build a robust, long time, sustained data management system. This must be a global data management system, not one fragmented by basin-scale issues, or regional views. A dialogue on this at top level is necessary also in CLIVAR. A better view is needed of CLIVAR requirements for products for every basin as well as descriptions for data delivery, transfer media, real time versus offline (10 days, 6 months), what type of data, etc. Argo can be used as an example when these issues are addressed. This will also support historical data archive issues. Information needed on requirements should include:

General Overview of the Requirement,
Products, Product Delivery, and Product-Service Chain Characteristics,
Character of the Inputs,
Input Delivery Requirements,
Quality Control/Assembly Requirements,
Character of the Processing (via data assimilation or direct for science use),
The Level of Feedback (how can CLIVAR contribute to improve the data or products),
State of Permanent Archives for Data and Products (needed improvements),
Strengths and Building Blocks,
Weaknesses and Needed Capacity,
Opportunities.

OOPC/GCOS/GOOS/JCOMM/IODE could offer a few data management experts to address the CLIVAR SSG on the issue and eventually what strategy CLIVAR should take on data management. Keeley and Smith would be the OOPC expert contacts.

7. DATA MANAGEMENT OVERVIEW

7.1 DATA AND INFORMATION TECHNOLOGY PROJECT

During OOPC-VI, the Panel had discussed extensively the question of an Ocean Data and Information Technology Project. Chairman Smith had agreed to pursue an initiative, jointly with Keeley and Dickey, to prepare for a GOOS-wide workshop. In partnership with the satellite community, the workshop would consider how best to serve the needs of basic science and operational applications.

OOPC VII continued its efforts towards an Ocean Information Technology Project (OIT). Core ideas from OOPC VI were reviewed. Smith noted that his report to the GOOS Steering Committee contained a request for a community response of ideas and suggestions for strategies. A first draft prospectus for a comprehensive OIT initiative had been circulated among the panel members. This prospectus provides a study on the fast expansion in the volume of ocean data and the necessity for an adequate management system. According to the study, failing to react with appropriate vigor to this challenge, would result in a serious limitation to future progress. Increasing demands of applied oceanography providing routine, reliable and sustained services are of equal importance. Only real-time data streams allow rapid turn-arounds of data and products needed for ocean forecasts that are sufficiently timely for managers to react effectively. In the past, too little priority has been placed on the complex field of data management. It is planned to circulate the draft prospectus amongst different communities comprising marine and environmental scientists, advocates and managers in oceanographic agencies, data centres and international organizations. An earlier e-mail poll in 2001 had already identified a number of critical limitations ranging from insufficient telemetry capacity to the lack of agreement on common standards or on a strategy and implementation plan for climate and physical oceanographic data.

The planned evolution of the OIT is to split it into a number of work packages. Their contents are to be refined in workshops with a broad consensus whenever possible, leading to an integrating Conference on implementation. Key issues will include:

- effective telecommunication,
- needs for agreed standards and protocols,
- provision for innovative data inquiries,
- interoperability independent of individual platforms, and
- involvement of developing countries and countries in transition.

The Panel learned that a first meeting towards an OIT is planned in Brussels in November 2002.

7.2 REAL TIME DATA SYSTEM AND DATA CODING

Keeley then briefed the Panel with respect to progress achieved since OOPC VI in real-time data systems and about further data identification coding studies. Issues focused on are:

- common protocols, standards and formats
- a marine climatology in meteorology
- collection of characteristic metadata for all sensors and platforms
- telecommunication needs depending on local facilities and available services.

Recent developments and studies of data flows moving from collecting platform via data centres to clients and end-users are described in Keeley's report on real-time data systems (see Annex XI). The Panel further took note of required attributes of ocean data identifiers and a hierarchy for them with 6 suggested copy levels. These are defined in Annex XII on Data ID Coding Studies. The Australian BoM has proposed the general usage of the cyclic redundancy check (CRC) algorithm to generate a unique identifier for a data set. Details are summarized in Annex XII.

8. SATELLITE MISSIONS

Johnny Johannessen reminded the Panel that within the next 4 years three new classes of satellite missions important to OOPC will be launched. They include missions dedicated for recovery of sea ice thickness (ICESsat and Cryosat), sea surface salinity (SMOS and Aquarius) and marine geoid (GRACE, launched in March 2002 and GOCE). Further specifications of these sensor principles including measurement specifications and retrieval accuracies are given in Johannessen *et al.*, (Observing the Oceans in the 21st Century, edited by Koblinsky and Smith). Launch dates and sensor types are listed below.

Satellite	Launch	Sensors
ICESsat	2002	Laser altimeter
Cryosat	2004	Radar Altimeter
SMOS	2006	L-Band passive microwave radiometer
Aquarius	2006?	L-Band passive and active microwave radiometer, radar
GRACE	2002 (in orbit)	Accelerometer + sat-to-sat low-low & high low tracking
GOCE	2005	Gradiometer + sat-to-sat high-low tracking

8.1 OCEAN SALINITY

Johannessen addressed the current status of the salinity measurements from SMOS. He emphasized that some of the demands for careful brightness temperature corrections associated with SMOS may be less demanding for Aquarius. As the approved NASA mission will fly both a passive and active L-band sensor, the field-of-view will be seen simultaneously by the two instruments. This makes it possible to make a better correction of the brightness temperature for sea surface slope (and therefore surface roughness) effects.

The quality of the sea surface salinity observations from the ESA SMOS mission will be highly sensitive to the accuracy of emissivity models. These models in turn depend on the ability to characterize and quantitatively describe the sea surface slope spectrum and the electromagnetic scattering. Johannessen listed some outstanding points (no preferred order) recommended for further investigation to obtain optimum results from the satellite measurements.

- High quality measurements of dielectric constant/or of T_B.
- More precise descriptions of sea surface slope spectrum.
- Rain effect, including attenuation, scattering and damping of the surface roughness, should be included in forward modeling.
- Careful validation experiments should be conducted in which sea surface slope spectrum is also measured, both in shallow water, deep ocean and for fetch-limited and fully developed seas.
- Skin temperature and its variation at L-band not well known and AMSR (C-band) channel should therefore be investigated in this context.
- Further testing and multi-variable error analyses based on image reconstruction for the SMOS configuration using the SMOS simulator.

Over the ocean the goal of the SMOS mission is to observe the sea surface salinity (SSS) with adequate accuracy and resolution as emphasized in major international scientific initiatives (i.e., GEWEX, GODAE and the Global Ocean-Atmosphere-Land System (GOALS) component of CLIVAR). The numerical ocean model simulation experiment based on the SMOS performance specifications, although preliminary, indicates the following::

Indian Ocean. Large scale SSS variability at spatial scales from 200 to 400 km measured every 10 days at 0.1 psu will be useful; at 0.05 psu it will lead to significant improvements from the current situation.

Atlantic Ocean. Large scale SSS variations are typically between 0.5 psu to 0.05 psu rms. Given a retrieval accuracy of 0.1 psu for 200 x 200 km x 10 days, a signal change of 0.1 psu over 1000 km should be detected with a 20% error. At seasonal cycle the error drops to 10%.

North Atlantic-Nordic Seas. Large scale 100 km to 200 km frontal variability in the Nordic Seas at 10 to 30 days should be recovered with accuracy of 0.1 psu. Seasonal signal (fresh water anomaly) will be detected with a 0.1 psu accuracy.

In order to consolidate these findings further, comprehensive ocean model simulation experiments must be undertaken. The timing of such simulation experiments would be ideal if coincident with the execution of the GODAE demonstration phase from 2003 to 2005.

Preliminary findings in the North Atlantic (Bentsen and Drange, 2002) further suggest a clear ocean response, including the SSS to the highly variable atmospheric forcing. Years 1948-1998 with high and low winter-NAO index forcings were grouped, and the differences in the ocean state between these years and the mean ocean state were examined. Some findings are described below.

< Significant changes in the SST were correlated with changes in the NAO index. For years with a high NAO index, the SST in the Nordic Seas, the Baltic and the sub-tropical Atlantic is up to 1ºC higher than normal, whereas the Irminger and Labrador Seas are up to 1ºC lower than normal. The opposite situation is the case for years with low NAO index. The extent and strength of the obtained three-pole pattern between the Nordic Seas, the Irminger and Labrador Seas, and the sub-tropics are generally in accordance with observations (Dickson, 1997).

< There were are also substantial differences found in the SSS and the thickness of the upper mixed layer between years with high and low NAO indices. The most prominent feature is the di-pole pattern between the Greenland Sea and the Labrador-Irminger Seas. This di-pole is caused by changes in both the SST and SSS.

< An apparent link exists between the thermohaline circulation (THC), the NAO index and the northern position of the Gulf Stream off the coast of the US (Bentsen and Drange, 2002). The North Atlantic Meridional Overturning varies with the production of intermediate to deep waters in the Labrador and Irminger Basins.

References:

Bentsen, M., H. Drange, T. Furevik, and T. Zhou, 2002: Variability of the Atlantic meridional overturning circulation in an isopycnic coordinate OGCM. Submitted to Climate Dynamics.

Dickson, R.R. et al., Long-term coordinated changes in the convective activity of the North Atlantic, Prog. Oceanography, 38, 241-295, 1996.

Orevik, K. A. , Ø. Skagseth and M. Mork, Atlantic inflow to the Nordic Seas: current structure and volume fluxes from moored current meters, VM-ADCP and Seasoar-CTD observations, 1995 to 1999. Deep-sea Research I, 48, 937-957, 2001.

8.2 SEA ICE

The chair pointed out that the we were fast approaching a promising capability to monitor sea ice variables from space and in situ, but there was little available from existing OOPC documents to provide guidance for a monitoring program. Accordingly, the Panel again focused its attention on sea ice (see also section 4.7). It was agreed that OOPC should develop a strategy document for sea ice. It would build on the information contained in the OceanObs99 papers (Johannessen, Drinkwater, in the proceedings) the CliC plans, the OOPC V Report, etc.. A rough outline was drawn up that included:

- A brief description of the rationale.
- What the system aims to deliver (operational and climate analyses, data sets).
- How the data will be obtained, for example:
  - Microwave imagers for distribution,
  - Radars for ice thickness and distribution,
  - Upward looking sonar (ULS),
  - SCAT and SAR ,
  - Historical data.
- How data are assembled to creat products.
- When and where data are available.

Johannessen mentioned that consideration was being given to a permanent ocean test facility that would serve a general purpose for satellite and other sensor calibrations . It could also serve as a time series station and/or SURFA site. This reinforced a view by Smith expressed earlier.

9. INVITED SCIENCE TALKS

In keeping with an OOPC tradition to include invited science talks from the host organization, Zenk arranged for presentations by Andreas Oschlies (a coupled modeler) and Douglas Wallace (Chair, IOC SCOR Ocean CO_2 Panel) from IFM-UNI Kiel.

Oschlies described a modeling experiment using altimeter and bio data to tune his model. The objective was to check a hypothesis that eddies can make the ocean bloom. It has been reasoned that eddies could fuel important events that produce nutrients (e.g., NO_3) that aren't detected when observations are made. In the experiment, atmospheric input is not considered. His model agrees well

with observations from the BATS (Bermuda Atlantic Time-series Station) site. His conclusion: eddies aren't the answer to making the deserts bloom; the contribution of nutrients from eddy-pumping is about 1/6 of that previously postulated. His explanation for the observations: other sources (e.g., N_2 fixing from the atmosphere, dust, organic material from the continents), wrong assumptions about diffusion, high interannual variability. Oschlies suggested a relationship between the NAO index and fisheries off the African coast in the tropics. A high NAO index is accompanied by high trade winds that produce strong upwelling off the African coast which in turn can affect the fisheries.

Wallace focused his presentation on the two current questions regarding ocean carbon:

A. Where are the carbon sinks and how much are they worth?
B. What are the controls on sinks and how sensitive are they to man-induced activities and global change?

Both questions can be addressed by models and observations of the global carbon cycle. B can also be addressed by experiments (e.g., IRONEX, etc.).

Wallace showed the NOAA CO_2 atmospheric observation network and noted that a paper by Fan and colleagues demonstrates that the atmospheric data can be manipulated by models to fit any set of obs. Wallace described other work by Wanninkhof and Takahashi (analyses of global pCO_2 obs showing role of ocean constraints on fluxes and atmospheric CO_2), CAVASOO (four VOS lines, e.g., M/V Falstaff cruise), ANIMATE (3 time-series moorings) and BATS (perhaps BRAVO and PIRATA I and II later). CO_2 analyzers, thermosalinographs, fluorometers and water samplers for C_{13} are used by the CAVASOO ships.

Wallace believed that there was great potential for exploiting container ships as routine observation platforms as near-autonomous instruments were becoming available. He envisioned the development of a portable self contained lab unit that could be loaded on and off containerships with minimal effort. The lab-unit would contain a suite of easily replaceable modular instruments (versions of modern analytical equipment) that are capable of operating automatically for periods of up to several weeks. Wallace suggested that POGO might be called on to use its influence to persuade ship-owners/builders, the IMO, etc, to consider in future container ship designs, provision for such an instrumented container-lab.

Notable points from the discussion:

- Enthusiasm for employing container ships for CO_2 obs is high; need to keep it going.
- A system of awarding "credits " for star performing ships should be considered as a motivator.
- Polarstern is an opportunity that needs to be exploited for CO_2 obs.
- There is a need for observers; on one Japanese line the cost of ½ a crew member is paid.

OOPC agreed it was time to develop a **?**Carbon Pilot Project" perhaps in collaboration with GCOS and GOOS and in some way to entrain POGO. The pilot project could include time series, hydrographic cruises and a VOS part for observations that are consistent with the Doney and Hood document and OceanObs99. Dickey emphasized the OOPC pilot project should include biogeochem obs as well. He was uncomfortable with leaving the open ocean to GOOS COOP. (Some of these issues were discussed in section 4.10.1 on Ocean Carbon Observations.)

10. NATIONAL REPORTS (and European Projects)

National reports were provided for Canada, France, Germany, Japan, Norway and UK. Zenk, Johannessen and Taylor contributed to a report on European Projects. They are contained in Annex XIII.

11. SUMMARY OF ACTION ITEMS

The actions resulting from discussions associated with the various agenda items are summarized in a table in Annex XIV.

12. NEXT MEETING

The Panel agreed to accept Keeley's invitation to hold OOPC-8 in Ottawa sometime during the week of 1 September 2003.

ANNEX I

AGENDA

1. OPENING

2. REVIEW AND ADOPTION OF THE AGENDA

3. PANEL REPORTS ON INTERSESSIONAL ACTIVITY

- 3.1 OOPC SUMMARY
  - **3.1.1 JCOMM**
- 3.2 GCOS
  - **3.2.1 The Second Adequacy Report**
  - **3.2.2 GCOS Steering Committee**
  - **3.2.3 GCOS Workshops**
  - **3.2.4 GCOS AOPC**
- 3.3 GOOS
  - **3.4.1 GOOS COOP**
  - **3.4.2 GOOS National Commitments**
- 3.4 WCRP
- 3.5 POGO

4. ONGOING OOPC ACTIVITIES

- 4.1 STATUS OF TAO/TRITON AND PIRATA ARRAYS
- 4.2 TROPICAL MOORING REVIEW
- 4.3 AIR-SEA FLUXES
- 4.4 VOS CLIMATE PROJECT
- 4.5 OBSERVING SYSTEM SENSITIVITY EXPERIMENTS (OSSES)
- 4.6 OCEAN CLIMATE INDICES
- 4.7 SST/SEA-ICE WORKING GROUP
- 4.8 SURFA
- 4.9 TIME-SERIES STATIONS
- 4.10 OCEAN CARBON
  - **4.10.1 Ocean Carbon Observations**
  - **4.10.2 Ocean Biochemistry Programs**

5. REGIONAL ACTIVITIES

- 5.1 INDIAN OCEAN MAURITIUS CONFERENCE
- 5.2 SOUTH ATLANTIC OCEAN WORKSHOP

6. EXPERIMENTS PROGRAMS AND PROJECTS

6.1 GODAE
6.2 ARGO
6.3 CLIVAR
6.3.1 Reanalysis Workshop
6.3.2 Data Management Issues

7. DATA MANAGEMENT OVERVIEW

7.1 DATA AND INFORMATION TECHNOLOGY PROJECT
7.2 REAL TIME DATA SYSTEM AND DATA CODING

8. SATELLITE MISSIONS

8.1 SALINITY
8.2 SEA ICE

9. INVITED SCIENCE TALKS

10. NATIONAL REPORTS (and European Projects)

11. SUMMARY OF ACTION ITEMS

12. NEXT MEETING

ANNEX II

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ANNEX III

SECOND ADEQUACY REPORT: STATUS BY PARAMETER

GCOS PowerPoint Presentation
Presented on behalf of Dr Paul J Mason, Chair, GCOS Steering Committee

KEY PARAMETERS FOR TREND DETECTION

A subset of the parameters important for:
understanding/describing the climate system and its inherent variability;
detection and attribution of climate change;
determination of climate forcings and feedbacks resulting from anthropogenic causes;
validation of models and prediction of future climates;
determination of the impacts of climate and climate change on human and natural systems;
and for which trends are vital and practical.

ATMOSPHERE:

SURFACE
- air temperature
- sea level pressure
- precipitation
- radiation budget
- wind
- humidity

UPPER AIR
- temperature
- humidity
- wind

AEROSOLS
- total optical depth
- stratospheric
- historical records

OZONE
- tropospheric
- stratospheric

GASES; Chemistry
- halocarbons
- carbon (cycle)
- TBD, trace gases: NO2 ; HF; HCl; CH4 ; BrO; ClO; N2O (above 100 hPa)

RADIATION BUDGET (TOA)
- downwelling solar
- outgoing longwave
- outgoing shortwave

OCEANOGRAPHIC:

SURFACE
- sea surface temperature
- upper ocean temp.
- sea surface salinity
- sea level
- sea ice
- ocean currents
- ocean wave heights
- ?ocean colour?

SUB-SURFACE
- ocean temperature
- ocean salinity
- ?biology?
- ?nutients?

TERRESTRIAL:

GLACIERS
- mass balance
- length

PERMAFROST
- borehole temperature

HYDROLOGY
- snow cover extent, depth
- streamflow
- landwater reservoirs
- groundwater, soil moisture
- evapotranspiration

ECOLOGY
- Flux net
- surface vegetative cover
- albedo (or under AOPC)

ANALYSIS OF KEY PARAMETERS. (Commentary on the following for each parameter.)

Main climate application
Contributing baseline GCOS observations
Other contributing observations
Significant data management issues
Analysis products
Current capability
Issues and priorities

PARAMETERS (Examples for surface air temperature and sea level)

SURFACE AIR TEMPERATURE

Main Climate Applications

Surface air temperature is the most important variable for determining the state of the climate system.
This is a key variable for detection of climate change and assessing the relative importance of anthropogenic and natural influences.
It is a prime driver of many impacts on natural and human created systems.

Contributing Baseline (GCOS) Observations

The GCOS surface network (GSN), is a subset of approximately 1000 stations that support the global network of locations that provide local and regional-scale observations.
The GSN promotes best practice and is a baseline against which to assess long-term homogeneity of the rest of the surface network.
On its own, the GSN is capable of determining change in the global surface temperature average, but must be augmented to provide detailed patterns of spatial change.

Other Contributing Observations

SYNOP network of 7000 surface recording stations.
Additional national and research observing networks.
Satellite observations, primarily IR but also some microwave.

Significant Data Management Issues

GSN data management is achieved by a combination of national data management organizations, GCOS GSN monitoring (DWD, JMA) and analysis (Hadley Centre, WDC-NCDC) centres, and CBS GCOS lead centers (DWD, JMA, NCDC).

Analysis Products

Time series for individual stations, regional averages, hemispheric averages, global averages.
Gridded fields via objective analysis and data synthesis.
Indices of trends, means, seasonal cycles, extreme events derived from daily maximum and minimum temperature observations.

Current Capability

Global annual surface temperatures can be assessed with an accuracy of +/- 0.1 degree C, which is adequate to detect global climate change especially since reliable monthly temperature data stretch back well over 100 years.
Analysis of indices of extremes derived from daily data is generally temporally limited to the last half-century or less and spatially limited to roughly 50% of the planetary land surface due to limited data digitization and exchange.

Issues and Priorities

Data archeology, digitization of longest available data records
Access to daily data
Homogenization of daily data as much as possible
Integration of satellite and in situ data
Testing climate model data sets against observational data products

SEA LEVEL

Main Climate Applications

This is a key variable for policy planning for global climate variability. Many island nations and nations with low-lying coastal regions are profoundly affected by changes in sea level.
This is also important for detection of climate change

Contributing Baseline (GCOS) Observations

The GLOSS network is a global array of approximately xxx water level gauges.
Some of these records extend more than 100 years.
Some of these stations have long term funding;

others depend on research program funding to maintain climate quality.

Other Contributing Observations

The attribution of sea level change requires that the water level sites be accurately located relative to the center of the planet. This can be done with Global Positioning System but is not done for most locations in the GLOSS network.

Accurate satellite observations of sea surface height variability, relative to the planetary geoid offer important additional information about sea level. At present these are produced by the TOPEX/POSEIDON and JASON satellite altimetry missions (GRACE, GOCE, ???)

Significant Data Management Issues

The GLOSS data are made available via ftp to all interested parties. Support is being sought to increase the availability of data in real time and to provide Web access.

Satellite altimeter data are available from several sources. The near-real time TOPEX/Poseidon data can be obtained via the GODAE Monterrey Server. The NASA PODAAC provides web access to scientific quality data. A subset of the GLOSS network are used to remove bias in the scientific quality satellite data.

Analysis Products

Global gridded fields of sea surface height anomaly, via objective analysis and data synthesis, are produced by several groups.

Indices of water level change and variability are produced locally.

Current Capability

Accuracy of GLOSS relative sea level is adequate, but continental movements are strongly confounding interpretation of sea level data in terms of global climate change. Until GPS precision location is done routinely at GLOSS sites, data interpretation will be challenging.

GLOSS global coverage is satisfactory, but regional interests require enhanced numbers of water level gauges.

Precision altimeter data is giving unprecedented information about changes in the large scale ocean circulation, which is important for global change detection and climate model evaluation.

Improved geoid information will be available in coming years and will permit improved characterization of the mean ocean circulation.

Issues and Priorities

Global routine geo-centric location of GLOSS sites is essential - implementation funding should be sought. Real time data reporting will need additional support.

Maintenance of high accuracy (TOPEX/POSEIDON or JASON quality) satellite sea surface height observations is essential. Maximum effectiveness of the satellite data for monitoring ocean circulation changes will require deployment of the recommended Upper Ocean Observing System.

Evaluation of the accuracy of knowledge about the global geoid, subsequent to the present generation of satellite geoid missions, will be a continuing need. The better the geoid is known, the more effective satellite altimetry will be in defining the global ocean circulation.

ANNEX IV

GOOS NATIONAL SUMMARY (SAMPLE FORMAT) AND SURFACE DRIFTER SUMMARY 5/29/02

Part 1 - GOOS NATIONAL SUMMARY (SAMPLE FORMAT)

France 5/29/02

National Contact Mr. Francois Gerard
Francois.Gerard@meteo.fr

Summary of operational and planned GOOS participation

Status Codes

Yes = On-going
U = Under Discussion
C = Contributor
P = Planned/Potential
N = None

Observations	***Status***	***Comments***
Surface Drifter	Yes	43 operational, 37 GTS (1/8/02) 33 " 30 " (3/20/02) 62 " 26 " (5/29/02) Questionable AP, SST, some with wind, some with T with Depth
	P	Atlantic: 15/yr, Indian Ocean: 5/yr plus equip 10 US SVP drifters with AP sensors.
Wave	Yes	2 directional wave riders near Antilles: Martinique and Guadeloupe
Mooring	Yes	Ocean Met Stations: Brittany, Gascogne, two off Antilles, one off Nice and Gulf of Leon
	Yes	Maintenance of TAO moorings along 165E
	Yes	PIRATA- Maintain 6 eastern sector moorings, two moored ADCP in 2001 to complement array. IRD-Contact: Rebert
	U	35N, 25W - CMs on source mooring, 2002-2004 (400, 1000, 1800m and 100m above bottom) IRD
XCTD/XBT/TSG	Yes	Operates 5 (see IRD) Atlantic and 12 Pacific ships with probe support from NOAA. About 3000 drops/yr

		SOOP summaries indicate XBT drops as: 1999-3863, 2000-2590, 2001- 2739 Contact: Rebert
	Yes	12 ships equipped with TSGs, Atlantic and Pacific http://noumea.ird.nc/ECOP/siteecopfr/cdsss.htm
ARGO/PORVOR	Yes	156 funded thru FY 2002, 45 operational April 2002 PORVOR tested with FSI and SEABIRD salinity sensors, 40 to be deployed by fall 2002
	P	Fund 160 FY 2003-2005
Other SS Floats	Yes	40 Marvors Active 11/1/01 (leCann)
Sea Level	Yes	15 GLOSS (6 not committed), 8 reporting regularly. Clipperton out of order, Dumont D'Urville no information, Le Robert and Pointe des Galets no recent data reported.
TS Hydrography	P	A25, every other year, herle.mercier@ifremer.fr
BIO/Chem	Yes	IBTS - two cruises in 2000 and 2001 (Thalassa) www.ifremer.fr/sismer/catal/campagne/campagna
Carbon Yes/P		Programs PROOF (every 3 months), OISO and ARGAU (with Argentina). A25, every 2 yrs, funded, began 1997 (Mercier) VOS-Astrolabe (with Australia), Hobart-Dumont D'Urville
Satellite	Yes	JASON-1 (T/P Altimeter), 12/2001-4 ENVISAT (ESA), 2002-7
	P	Wave mission (formerly called VAGSAT) Sea Surface Salinity - SMOS, 2005-8 JASON- 2, 2006-8
Sea Ice N		
VOS	Yes	Operates 83 VOS (June 2001). French automated system, BATOS, is progressively (16 thru 2000) replacing conventional systems.
		VOSCLIM Participant
ASAP/WRAP	Yes	E-ASAP(European), 4 ships France to West Indies 1360 reports in 2000 (JCOMMOPS) 1385 reports in 2001 "
	C	WRAP - Support, funds

Coastal Met Yes See moorings above

Projects/Products

Global UOT/SSS Center <www.brest.ird.fr/soopip/>

GODAE/Mercator project -- simulation of the global ocean at high resolution with primitive equations assimilating satellite and in-situ data.
www.mercator.eu.org
http://bulletin.mercator.com.fr

CORIOLIS - Operational Center in Brest (ARGO plus)

JCOMMOPS Center www.jacommops.org

FERRYBOX

MFS - Med Forecasting System

Underway SSS Data Archiving PP

SeaNet

Gyroscope

Affiliations

EuroGOOS

MedGOOS

EGOS of DBCP (European)

IBPIO of DBCP (Indian Ocean)

DBCP

Part 2 - SURFACE DRIFTER SUMMARY 5/29/02

Program Aim - 1250 Active Drifters at all times

Active drifters/number of drifters from which data are inserted on GTS

	9/14/01	12/03/01	3/20/02	5/29/02
Australia	18/15	29/15	44/20	23/21

Brazil	15/12	13/9	10/8	11/9
Canada *	12/9	10/2	13/2	24/2
China	8/0	10/0	5/0	5/0
Denmark	1/0	-	-	-
Finland	-	-	1/0	1/0
France *	46/43	42/40	33/30	62/26
Germany*	32/6	29/7	29/10	25/10
India	9/5	11/4	6/3	11/8
Ireland	1/0	-	-	5/0
Italy	9/0	9/0	9/0	7/0
Japan	61/30	55/29	51/25	20/5
Korea	12/0	9/0	14/0	8/0
Netherlands	3/3	3/3	2/2	4/4
New Zealand	13/6	8/6	10/8	8/7
Norway	12/6	11/9	17/8	9/7
South Africa	18/11	18/13	20/15	19/14
Spain	-	1/0	-	-
Taiwan	-	-	-	1/0
United Kingdom	58/40	57/41	62/32	49/28
United States	897/575	847/487	735/413	702/360
Total Active	1225	1162	1061	994
% 0n GTS	62	57	54	50

Source of information: http://dbcp.nos.noaa.gov/dbcp/statact.gif

*Adjusted by BJT thru 3/20/02 to remove Subsurface Floats that were reported as surface drifters. JCOMMOPS reviewing 5/29/02 entries.

Part 3 - SEA LEVEL SUMMARY 19 APRIL 2002

	Stations		Reporting Well		Latest Data	
	DM	FAST	DM	FAST	DM	FAST
Australia	22	7	20	7	2000	2002
Brazil	9	1	0	0	1993	2-5/2000 only
Canada	6	4	4	4	2000	2002
Chile	8	6	8	4	1999	2002
China	5		0		1997	
Colombia	3		3		1999	
Cuba	3		3		1999	

Denmark	5		2		1999	
Ecuador	2	2	2	2	2000	2002
France	15	6	8	6	2000	2002
Fiji	1	2	1	2	2000	2002
Germany	1		1		2000	
Iceland	1		1		2000	
India	8		0		1996	
Japan	11	9	11	9	2000	2002
Kenya	1	2	1	2	1999	2002
Korea	1		1		1999	
Mauritius	2	2	2	2	1999	2002
New Zealand	5	1	0	1	1998	2002
Nigeria		1		0		1996
Norway	5		3		2000	
Russia	14		5		2000	
S. Africa	4		0		1997	
Spain	3		3		2000	
Sweden	1		1		2000	
United Kingdom	13	9	10	4	2000	2002
United States	27	30	25	30	2000	2002

Notes: Delayed Mode (DM) information from GLOSS October 2001 Status summary. FAST information (i.e. data availability within a week or so), from University of Hawaii Center, 4/8/02. Overlap between stations exists but is not 100%.
Reporting well: DM data received through 1998, FAST data received through 2001.
Some additional data are available at BODC (DM) but not yet on their web site.

Countries listed are being tracked for GOOS assessment. A few other GOOS participants have identified stations but they do not appear in either DM or FAST datasets. Most, if not all, countries have additional stations that are not part of the "GOOS" sea level program at this time.

ANNEX V

TROPICAL MOORED BUOY IMPLEMENTATION PANEL SUMMARY

(prepared for JCOMM Workshop, La Jolla, California 24-27 April 2002)

Michael McPhaden, Chairman of the Tropical Moored Buoy Implementation Panel, reviewed the status and plans for tropical moored buoy programs in support GOOS, GCOS, and CLIVAR. In the Pacific, the TAO/TRITON array continues to serve a wide community of scientists involved in seasonal-to-interannual climate research and forecasting. The data from this array underpins recent forecasts issued by NCEP and WMO of developing warm conditions in the tropical Pacific for 2002 (view these conditions at http://www.pmel.noaa.gov/tao/jsdisplay/). Various extensions and enhancements to TAO/TRITON were also reviewed, including PACS/EPIC along 95W and ongoing or planned South American buoy programs sponsored by Peru, Ecuador, and Chile.

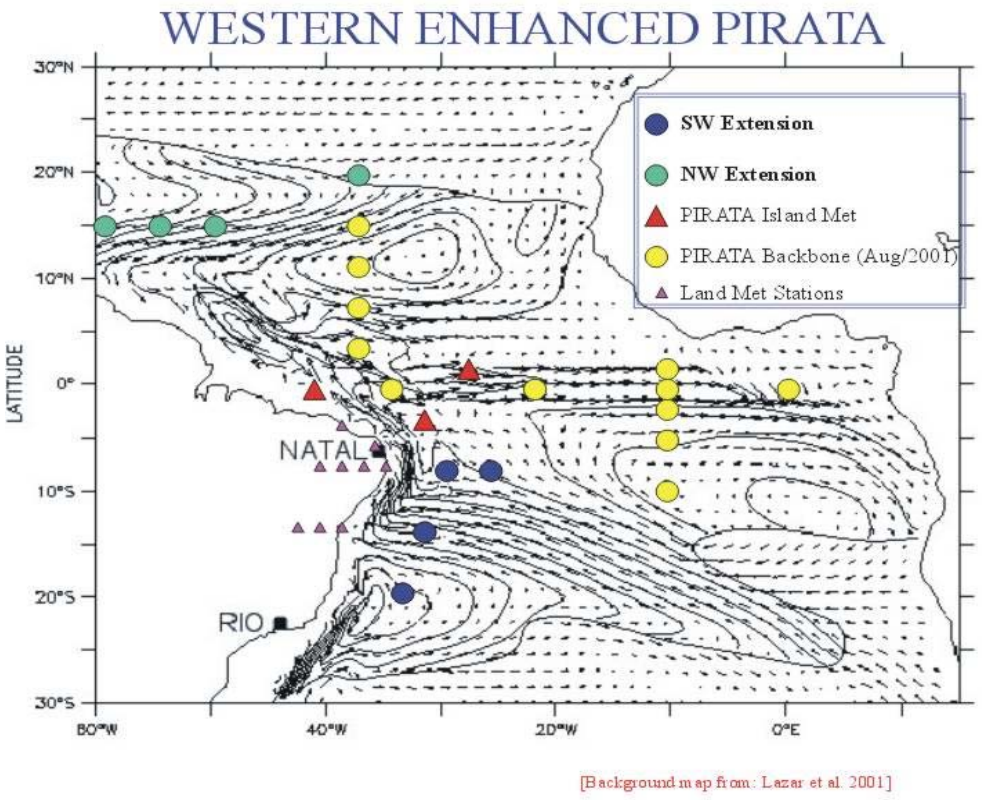
In the Atlantic, the French, Brazilian, US PIRATA array is being continued for a 5-year "Consolidation Phase" (2001-2005). The three countries signed a memorandum of understanding in Paris in August 2001 to support this effort. Northwestern and southeastern extensions to PIRATA are planned but are as yet unfunded. There have also been discussions about instituting a Brazilian base of operations in Natal to support long-term operations for PIRATA and other elements of GOOS. Adequacy of ship time is an issue in the Atlantic. Less frequent buoy servicing (once vs. twice per year) compared to much of the Pacific adversely affects data return.

In the Indian Ocean, efforts are underway to establish an initial moored buoy network for climate studies. These efforts include two JAMSTEC TRITON buoys deployed at 1.5S, 90E and 5S, 95E in October 2001 and the buoys of the Indian National Data Buoy Program in the Arabian Sea, Bay of Bengal and along the equator. There are interests in further building on these efforts through initiatives put forward by South Africa in collaboration with neighboring countries, within US academic and government labs, and others. A workshop will be held in Mauritius later in 2002 under auspices of the IOC to continue this coordination and development effort.

Vandalism by fishing fleets continues to be a problem in all three oceans. Regions particularly hard hit are the far eastern and western Pacific and the Gulf of Guinea in the Atlantic. In the Indian Ocean, there are reports of vandalism to the JAMSTEC buoys and to the buoys maintained by India. Outreach and engineering efforts to address this problem continue, but they are of limited success.

ANNEX VI

WESTERN ENHANCED PIRATA



ANNEX VII

SMALL SURFACE EXPOSURE TELEMETERING BUOY

Small affordable telemetry buoys were discussed during OOPC-VII as an alternative to the tall toroid ATLAS type repeatedly being a victim of vandalism in the tropical oceans. The small, experimental telemetry buoy illustrated below, was suggested by Walter Zenk as a potential candidate for areas where direct wind measurements are not critical. Indirect wind and/or precipitation observations may be achievable by such small buoys by implementing acoustic underwater sensors for meteorological parameters.

The photo was taken during preparation for deployment on board the French R/V L'ATALANTE in February 2002. The instrument is part of the long-term observational project MOVE (Meridional Overturning Variability Experiment) in the tropical Atlantic as part of the German contribution to CLIVAR. Its mooring position lies near 15°N, 51°W representing a northern extension of the equatorial PIRATA array. The photo shows the transmitting buoy upside down on the ship's stern with the receiving electrode (metal sheet) as a limb of the inductive circuit. The one-conductor cable acts as a tether rope. It is terminated on the extension of the buoy's mounting plate. Daily transmissions of first-class stratification data from the upper 100 meters were received and made publicly available at IfM Kiel until this buoy brook loose in early summer of 2002. It was recovered later by R/V KNORR operating in the same region.

ANNEX VIII

WGASF WORKSHOP SUMMARY
Washington D.C., May 2001

Three days of the Workshop were devoted to scientific presentations grouped as: Keynote Talks (including a review of the WGASF report); Flux Products from Modelling and Data Assimilation; Validation of Flux Products; Fields from Remote Sensing; and Measurements and Parameterizations. The fourth day was spent in Breakout Groups whose recommendations may be briefly summarised as follows.

Breakout Group 1 on "Parameterizations and Measurement" suggested the need for:

- an Airflow Distortion Experiment comparing a research ship with suitable reference platforms;
- a Technical Manual on Air-Sea Measurement Methods;
- a Radiation Measurement Comparison experiment to compare ship-borne instrumentation with a platform that is fully instrumented to Baseline Surface Radiation Network standards;
- a Marine Flux-Profile Experiment and Coastal Ocean Case Study experiments.

Breakout Group 2 on "Verification" stressed the importance of:

- validating air-sea flux data sets by comparison to high-quality observations, in which respect it supported the planned activities of SURFA to verify the near-surface fields from numerical weather prediction (NWP) centres using high-quality observations;
- requiring error estimates for all air-sea flux data sets - these could be developed from the statistics compiled from data assimilation at NWP centres; and
- an extensive intercomparison of all flux fields - this is still necessary.

The WGASF on-line catalogue of flux fields should be expanded and include the evaluations. Indeed, there is an outstanding need to ensure the open distribution, preservation and availability of air-sea flux data sets and products. Finally, new methods of direct precipitation measurement over the ocean are desirable.

Breakout Group 3 on "Flux Field Improvement In The Future" identified needs to:

- combine flux and meteorological products from different sources including satellite data;
- achieve more timely delivery; to provide detailed error estimates, particularly the space-time distribution of error covariances; and
- provide all flux data sets with metadata (including a comprehensive buoy metadata catalogue).

Required improvements to flux products include increased spatial and temporal resolution, parameterizations that are valid over a wider range of environmental conditions and better radiative flux estimates. The use of various flux fields as forcing functions for atmospheric and oceanic general circulation models would identify errors in the products and help validate the flux fields. Support was stated for the proposed Global Precipitation Mission (GPM), reference site buoys, development and maintenance of in situ data archives accompanied by the collocated satellite data (e.g. SEAFLUX), and efforts to improve and qualify VOS observations (e.g. the VOSClim project). Also to be supported were: regional flux field synthesis and validation, analysis of large-scale heat and fresh water imbalances, validation and improvement of the wind stress fields and improvement of the long-term space-time series of global sea-air flux anomalies.

The full report of the workshop has been published as WCRP-115, WCRP/SCOR Workshop on Intercomparison and Validation of Ocean-Atmosphere Flux Fields, August 2001. It includes all the main findings, conclusions and recommendations as well as extended abstracts of the presentations. It can also be accessed via the WGASF web site: .http://www.soc.soton.ac.uk/JRD/MET/WGASF/

ANNEX IX

THE CLIVAR/OOPC/IAI WORKSHOP ON THE SOUTH ATLANTIC CLIMATE OBSERVING SYSTEM

Planning Notes as of 8 June 2002

Prepared by Edmo Campos

Venue: Sao Paulo or Rio (depending on Janice Trotte)
Period: Feb/Mar 2003
Host Institution ???? (depends on Janice being or not the local hostess)
Sponsors: ???? (WCRP, IOC, IAI, POGO)

Organizing Committee: (It was suggested that this should be kept at a lower number. There's no need for the white papers lead-authors to be members of the organizing committee)

- Edmo Campos, Brazil
- Janice Trotte, Brazil
- Ilana Wainer
- Carlos Ereño, Argentina
- Alberto Piola, Argentina
- Johann Lutjeharms, South Africa
- Chris Reason, South Africa
- Ricardo Matano, U.S.A.
- Walter Zenk, Germany

(Historics and organizational status:
The idea was brought up during OOPC VI;
Unofficially endorsed by CLIVAR (J. Gould, M. Visbeck);
Officially endorsed by OOPC;
Waiting for CLIVAR official endorsement)

Scientific Backgrounds

The South Atlantic Ocean connects the three major ocean basins: The Pacific Ocean, the Atlantic Ocean and the Indian Ocean. The meridional gaps between the continents of the Southern Hemisphere and Antarctica allow for a free exchange of water among the basins. The South Atlantic is a peculiar ocean because it is the only basin, in which the net meridional heat flow is equatorward, resulting in a cross equatorial export of heat towards the Northern Hemisphere. This fact is crucial to properly model and forecast the Northern Hemisphere weather and climate. Compared to the North Atlantic and the Pacific, the oceanic circulation in the South Atlantic, and therefore how this heat is transported to the north, is poorly understood.

It was not until very recently that the concept of the need of observing the World Ocean either to understand climate changes or weather forecasts for northern hemispheric countries was embraced. With respect to including the South Atlantic in this context, it is important to decide

on a few control points and key processes, and propose an observational and modeling program for studying them in the next decade. Considering the present knowledge on the Atlantic Intermediate water (AAIW) pathways in the South Atlantic, three important regions are identified: the Brazil/Malvinas Confluence (BMC), the Agulhas retroflection and the area of the bifurcation of the South Equatorial Current (SEC). While it seems clear that the variability in the Brazil/Malvinas Confluence is important to regional climate, the connection to the global system is poorly understood and needs to be further investigated. There are speculations that the spatial variability on the Brazil/Malvinas Confluence location could interplay with the AAIW and thus, have an impact on the thermohaline circulation.

Although there are not many studies showing solid evidence of the connections between the SEC bifurcation and the MOC and/or Brazil/Malvinas Confluence, the SEC bifurcation is indubitably an important feature of the South Atlantic circulation. There have been remarkably few studies of the region, and there are still several unanswered questions regarding the location and spatio-temporal variability of the bifurcation.

Another region that requires special attention because of its role in the thermohaline circulation lies near the southern tip of South Africa where the Indian to Atlantic inter-ocean exchange takes place. One of the key questions still to be answered is how much heat and salt is transferred from the Indian to the Atlantic Ocean. The pathways of AAIW once it enters the Atlantic and moves to the north are poorly known.

Motivation

The Workshop is motivated by the belief that South Atlantic might play an important role in the workings of the Global Climate. In spite of this, the South Atlantic is one of the less studied part of the world ocean. It is also believed that the contribution of the South Atlantic countries is essential in properly addressing the problem. Considering their strategic locations, these countries could greatly contribute in the development of the observing system for their part of the world. The boundaries of the South Atlantic are mostly developing or underdeveloped countries with almost no financial resources to observe the ocean as needed. This lack of resources causes spatial and temporal gaps in the observations and results in poor climate forecasts. The proposed observations should be considered as a way to fill these crucial gaps, to form partnerships with the countries of the southern hemisphere, to train their technicians to collect the needed observations and to reduce the costs via these partnerships.

Workshop Goals

- 1) To discuss the observing system requirements for understanding the role of the South Atlantic in the climate system, both on regional and global scales. From these discussions we hope to:

o a. Identify common interests in ocean observing systems
o b. Identify social and economic applications of data of joint/common interest
o c. Provide an overview of scientific understanding of South Atlantic oceanic and climatic variability

o d. Identify the key locations and processes which need to be addressed in the next few years.

- 2) Develop multinational action-plans to:

o a. Review national commitments and plans for research and operational observations
o b. Survey the need for data management activities, including historical data
o c. Develop joint actions and seek cooperation in proposals
o d. Agree on the principles of the long-term strategy

Structure

The Workshop will be structured around a series of Discussion and Review short papers (2-3 pages), interspersed with discussion-sessions to develop cross-cutting ideas and consensus. The Papers will be prepared by groups of Lead Authors, selected for their specialist knowledge. The number of Workshop participants will be limited to about 35.

Discussion Papers

1) Review of interannual variability and climate prediction. (Chris Thorncroft/Paulo Nobre)

- a. What do we already know about climate in the South Atlantic Ocean from TOGA, WOCE and CLIVAR?
- a. What are the burning scientific questions now?
- b. Where and in what aspects are we most likely to develop useful climate predictions?
- c. What and where are sustained observations needed to observe climatic variability and develop applications?

2) Review of intra-seasonal variability and/or process studies. (Alberto Piola/Silvia Garzoli)

- a. What do we need to know to underpin intra-seasonal and seasonal prediction?
- b. Scientific overview of recent research cruises and process studies
- c. What experiments are required for future process understanding?
- d. Are there implications for the observing system from knowledge of the American Monsoon System?
- e. What and where are sustained observations warranted as a framework for process studies?

3) Instruments, technologies and Satellite (2 papers) (Walter Zenk/Johnny Johannessen)

- a. What instruments are available or planned for South Atlantic Ocean observations?
- a. Overview of remote sensing of SST, wind, sea level, color, salinity
- b. Overview of new in-situ instruments and methods--Argo floats, gliders, acoustic thermometry, others? Where does the greatest potential lie?
- c. Required innovation and technological challenges
- d. Commercial opportunities (for example, manufacture of instruments; satellite

communication)

4) Ocean applications and ocean prediction. (Ilana Wainer/Carolina Vera)

- a. Overview of GOOS Coastal applications and relationship to GODAE
- b. Fine scale analysis of SST and color, application to fisheries
- c. Storm surge and related extreme event forecasts for the ocean
- d. Developing a better information system for the South Atlantic Ocean, including better real-time and climate databases and re-analysis products.
- e. Other applications

5) Applications of ocean- and climate-prediction requiring long lead-time (several months). (Paulo Nobre/Chris Reason)

- a. Teleconnections--from oceans to terrestrial climate impacts Social and economic
- b. Applications of ocean-climate data to farm-management
- c. The role of the South Atlantic Ocean in climate change assessments and scenario predictions

6) Overview of existing and planned observations (Edmo Campos/Johann Lutjeharms)

- b. Status of present-day sustained observations in the South Atlantic Ocean
- a. National plans for future sustained observations
- b. Main Stakeholders
- c. South American and African Met and Climate services
- d. Research programs
- e. Cooperative programs with northern hemisphere countries/institutions

7) Inter-Ocean Exchanges (Ricardo Matano/Martin Visbeck)

- a. The South Atlantic as the connection between the North Atlantic and the other oceans
- b. The relative importance of the different entry points
- a. Overlaps with the CLIVAR regional panels (Atlantic, Southern Ocean, VAMOS)

8) Application, services and commercial opportunities - (Miriam Andrioli)
- a. Climate, weather and ocean services
- b. Application opportunities for the SA region
- c. Commercial opportunities for technology and services

ANNEX X

ARGO DATA MANAGEMENT

General Description and Status of the Data System

The Argo data system is a distributed operation. In most cases, individual countries manage the data stream from the floats they have deployed. Data are relayed from the Data Assembly Centres, DACs, to the GTS and to two global servers, GDACs, operated by France and the US. Data are available either from the GTS in TESAC code form, or through either ftp or www access from the GDACs. As the data pass through more strict quality assessments, the data on the GDACs are replaced by the higher quality versions. An archive has been established at the US NODC to ensure the accessibility of the data over time.

Most countries have established DACs for their data or are collaborating with other countries or Service Argos to share resources. They receive the data stream through Service Argos, convert it to profiles, subject the data to standard real-time QC procedures, build the TESAC message and distribute the data to the GTS. The goal of Argo is to have data on the GTS within 24 hours of the float coming to the surface. At the present time, about 50% of the global submissions are meeting the target.

The two GDACs are in place and act as mirror sites. Mirroring software has been tested and now operates between the two sites. Each has an ftp sever operating. The ftp server organizes the data by observation date and time, by ocean basin and by contributor. Each intends to have a www server. The software for the server in France is closer to completion.

The data found on the GDACs at present derive from the GTS. This covers the period until individual DACs are able to process their data and deliver them in the agreed format. It is expected that a few countries will have automatic transfers to the global servers in operation soon.

There is the intention to establish regional data centres. These groups will undertake to look at float data on basin scales to generate products and check data consistency. The formation of these groups is still under development. At the last Science Team Meeting, a number of groups expressed interest in becoming or partnering in regional centres.

A tracking system to show the development of the data system has been established at the AIC. Each DAC and GDAC is encouraged to use this to report progress on their implementation.

Meetings

The first formal meeting of the Argo Data Management Team was held in Brest in November 2001. Participants from Canada, France, Germany, Japan, Korea, Russia, USA, UK attended.

The agenda covered preparation of data system documentation, a data exchange format,

standardization of quality control procedures, operations of data servers and data flow, the operations of the Argo Information Centre, products and other matters. The most intense discussion took place surrounding those components of the data system that would implement exchange of the data.

A second meeting is planned for Ottawa from 18-20 September, 2002 and hosted by MEDS. Work will continue on implementing the various components of the data system.

Current activities include:

· the completion of the first version of an Argo Data Handbook,
· making routine the exchange of real-time data with the GDACs,
· evaluating real-time quality control procedures,
· establishing exchanges of delayed mode data between PIs, DACs and GDACs,
· establishing regional data centres and incorporating their activities into the data system,
· developing a suite of products to demonstrate the use of Argo data,
· testing delayed mode quality control procedures with the goal of standardizing these.
· ensure the AIC meets Argo needs,
· establish the functions required of the long term archive relative to the GDACs.

Issues

Data are presently being served from the GDACs, but these are the data derived from GTS transmissions in TESAC code form. As such, they are missing any data that did not pass the real-time QC procedures. In addition the metadata about each float and surface drift information have not yet appeared on the global servers. All this will develop as individual DACs progress their data handling systems. Still, more floats are being deployed and this development must move as quickly as possible.

The handling of the delayed mode data is less well developed. Simply moving the data between DACs and PIs is not well established everywhere. Coupled to this is a need to resolve standard QC procedures to be applied by PIs. A scheme by Wong was presented at the last AST meeting in Hobart (March, 2002). PIs present were mostly unfamiliar with the proposed technique and so some experimentation with it will be required before general acceptance and implementation.

The AST meeting accepted arguments in favour of regional centres that would undertake analyses based on all profiling float data from ocean. A number of groups expressed interest in undertaking these activities either by themselves in or cooperation with others. There remains to describe the minimum roles and responsibilities of these centres to ensure consistency and eliminate uncertainties in work required. There also remains to solidify the groups who will commit to the work.

Argo needs to be able to demonstrate how well it is meeting objectives, to show tangible scientific results, and to promote itself. A suite of products for these purposes is under consideration with some being better defined / developed than others. The upcoming Data Management meeting in Ottawa (Sep, 2002) will address this issue and solicit groups to generate

agreed products. The AIC will be the means to distribute the products.

Despite the broad reach of the Internet, it is still not a viable means for people in many countries to obtain data, information or products from Argo. It has been suggested that the periodic (perhaps frequent) creation and wide distribution of hard copies of data and information, such as on CDs, should be done. Additionally, though netCDF meets a number of needs, it is a format that requires a certain level of software support that is not globally available. An ASCII format for the data has been suggested. These ideas will be discussed at the upcoming Ottawa meeting.

Programmes such as SOOP contribute upper ocean profiles to the global archives and complement the data coming from profiling floats. Additionally, profiling float data can be expected to be used in combination with bio-geo-chemical data as the GOOS develops. The way to integrate these different sources of data has not been determined. This may happen through the functions provided by the Long Term Archive facility for Argo data, the U.S. NODC, and / or through cooperation with existing global data management systems. There remains to define the roles and responsibilities of the Long Term Archive facility in the context of the GDACs. There also remains work to connect the Argo data to existing international systems.

ANNEX XI

REAL-TIME DATA SYSTEM

The Present Systems

Data from collectors. Ships and other platforms at sea use a variety of communications systems to send data to shore. Argo uses Service Argos at present, but may well switch to Iridium soon if the technology proves out. Ships use Inmarsat, perhaps some still use GOES, and Service Argos as well. Once ashore, the GTS still remains the main routing for in-situ data distribution internationally. The Internet is also used extensively for certain programmes, Data systems such as Argo are placing data on Internet servers at the same time as data go to the GTS. In this case, the Internet servers hold all of the data and metadata, while the GTS gets only those data having passed automated quality control procedures with quite limited metadata.

Data to clients. There are a variety of channels for data to reach clients, depending on the type of data, the timeliness required, and the degree of processing desired. Access to the GTS is available to those working in meteorological centres. There are also a few oceanographic centres with operational links.

There are a number of older and newer data serving initiatives that could make the real-time data available quickly. Within Argo, not only is there the ftp server, but there is also a www server that allows for browsing through the available data and metadata. This includes some visualization tools. The DODS and Live Access servers also could make real-time data available if the data were to be placed on such servers. At the moment only delayed mode data are available from such sources.

There is also the initiative to provide access to data using CORBA technology. This is a joint project between NODC, U Hawaii and PMEL. They have a first version operating in a limited way, but work is continuing. MEDS and NODC are collaborating on a scheme for real-time data collected by MEDS to be served to the Internet.

Real-time wave data from North American wave buoys are available from Canadian (MEDS - statistics only at present) and American (NDBC - statistics and spectra) internet sites. These organizations have begun a collaborative effort to offer similar services, e.g. data in common formats and presentation modes for the data and information. There are limited other wave data available in real-time.

New Developments

A Surface Underway project been initiated and a draft project plan will be available by September 2002. There is also an offer by JCOMM to cooperate with the project and to include pCO2 data. This is hoped to be carried out in the context of the Ocean Information Technology **Pilot Project.**

The JCOMM Data Management Coordination Group recently met and formulated 4 OIT work packages. The one referenced to in 9.1 proposes to look at how to combine the data and information from four Ship Observation data streams, SOOP, VOSClim, Underway and ASAP. All of these data are available in real-time on the GTS so this will be one aspect of the work. There will be a need to look at standard ways to report the data and information about the data collection. This would include quality control procedures and results, data processing applied, instrumentation information, etc. Proposals are being prepared to be submitted to the OIT Steering Group in November 2002.

Within the JCOMM Observations Programme Area, an effort is underway to develop performance metrics. Readily understandable maps and/or displays will be used to show how well the observation systems are meeting GOOS requirements. A task team consisting of Stan Wilson, Bob Keeley and Etienne Charpentier are working on this now.

Within GTSPP, work has been started to incorporate a scheme for the unique identification of real-time and delayed mode data. MEDS, BoM and the SEAS program are collaborating in this work. As experience is gained, it is the intention to extend the application to all other data sources handled by the programs.

ANNEX XII

DATA IDENTIFICATION CODING STUDIES

At the last OOPC meeting the need for a unique data identifier to assist in the resolution of data copies was described. Since that time, A number of groups have presented possible ideas but the one with the most promise appears to be one originating from the BOM in Australia. Before describing this scheme, it is important to recall how such copies arise today.

Creation of Copies.

Assume a ship collects profiles of temperature, salinity, oxygen and perhaps other variables. This is the original version of the data, copy 1.

Copy 2: The temperature and salinity data are always subsampled to create a TESAC message for distribution on the GTS. The time and location information is taken from ship's instruments at the time. A ship identifier is also attached. The TESAC forms the second copy of the original data but with only T and /or S and at reduced vertical resolution

Copy 3: The real-time data come to a centre that takes the data from the GTS. In the course of their QC they discover an error in the reported position. In some cases, the source is obvious (such as forgetting to change the sign of the latitude as the ship crosses the equator) and can be corrected. This corrected version is now the third copy with some of the information altered.

Copy 4: The original data from the ship come ashore and pass through quality control and analysis by the PI and his institution. They sometimes discover problems, more often in the position or time information, and make suitable corrections or deletions from the data files. They send these files to the national or international data system. This is now copy 4 at full resolution, often with more variables that reported in real-time but with differences.

Copies 5, 6, etc.: Users get data from the global / national data system and they may resample, or discover other problems in the data that are correctable. Over time, these data get back to the data system creating more copies of the original with different values and different resolution

Required Attributes of an Identifier.

To help resolve these multiple copies an identifier:
· Must be attached to the data as soon after collection as possible.
· Must be carried with the data at all times
· Should be able to be generated independently of any oversight organization
· Should be able to be generated from the data where formats (such as the GTS) allow no flexibility to add information.

The BOM scheme and its application.

The BOM proposes to use the widely available 32-bit CRC (cyclic redundancy check) algorithm to generate a unique identifier for a station of data. This algorithm takes a seed value and a string of characters and generates a CRC value. Everyone must use the same seed value.

Its general application is as follows. When a temperature or temperature and salinity profile is collected, a BATHY or TESAC message is created using whatever software is desired. The exact GTS message that will be distributed is then passed through the CRC routine that uses everything after the 888 group to calculate the identifying tag. The message is then issued to the GTS and the tag is attached to the full resolution data.

Any organization receiving the GTS message can use a CRC routine with the same seed value to regenerate the unique identifier from the message. This then can be passed to the organization responsible for resolving real-time and delayed mode copies. Since the delayed mode data will arrive with the same identifier as computed from the GTS message, no matter how the content may have changed as a result of QC, there will be no question that the data originated from the same source.

If no real-time data distribution is intended, the CRC value can be calculated from the original data and attached to the station. As long as this identifier stays with the data, as multiple copies are created, it will be clear that the copies all started from the same data.

Determining the best copy.

The CRC value simply tells if multiple copies all started from the same source, but not, which is the best one to use. To determine this, additional information must be used. This is where the Data State Indicator (DSI) is of use, or looking at the processing history of the data. As a general rule, data that have a "higher" DSI have passed through a higher level of scrutiny and therefore would be considered the better version of the data. The processing history information would provide greater precision of what level of scrutiny has been applied.

Progress in implementation.

GTSPP has committed to implementing the BOM solution. MEDS and BOM are collaborating to verify that their respective CRC algorithms work as expected. Discussions are underway with the SEAS programme in the U.S. to have them calculate the CRC value to attach to the delayed mode data they send to the US NODC. We will expand the number of contributors using this scheme as we gain experience.

ANNEX XIII

NATIONAL REPORTS

Informal National Reports on implementing ocean observing systems were provided for Canada, France, Germany, Japan, Norway, UK and the European Community by Panel members.

National Report for Canada submitted by R. Keeley

Argo

Canada has deployed 47 profiling floats, of which 3 predated Argo and now are no longer functioning. Of the 44 floats deployed over the last 10 months, 2 failed to report immediately after deployment, and 7 others are late reporting and possibly non-functioning. A number of the floats we deployed had a ballasting problem which caused them to be unable to reach the surface when there was a fresher surface layer. As the layer breaks down, the floats are able to get to the surface and to report. This has already happened with at least one float and we suspect 2 others may be affected this way. We have had discussions with the manufacturer about the problem.

We have 4 floats reporting from the Atlantic Ocean, close to Canada's east coast, one in the Indian Ocean in cooperation with Indian colleagues and the rest in the Northwest Pacific. At the start of 2002 there were 29 floats awaiting deployment. We shortly will be deploying more in the Atlantic, and are looking to deploy an array of 6 off the coast of Chile.

All of the data are handled through MEDS. They acquire the data from Service Argos, convert to profiles, issue the data to the GTS and send the data to the PIs in Canada. MEDS is carrying out final checks on the netCDF metadata format in conjunction with the GDACs. When all is well, they will begin to upload real-time data to the GDACs. They are also working with the PIs to get the delayed mode QC done and to provide these data to the GDACs as they are ready.

Canada started 2002 with 29 floats waiting for deployment.
As co-chair of the Argo Data Management Team, Bob Keeley of MEDS, is also working to get the entire Argo data system in place.

Wave Data

Wave data in Canada are collected by instrumented wave buoys operating off both east and west coasts of Canada (23 in total) and eleven in the Great Lakes. The buoys are of the NDBC design. They are operated by the Meteorological Service of Canada and report hourly wave spectra and surface meteorological measurements. Information is reported in real-time on the GTS using the BBXX code form. MEDS acquires the full suite of data, including the wave spectra, archives them and provides them to clients. At present, only the statistical information about the wave measurements are available through the MEDS web site. However, MEDS and NDBC are beginning a partnership to build a distributed system of access to instrumented wave data from North America. Initial steps will be to provide better coordination of the data and information each offers from their web sites. In the longer term, we expect to provide a seamless window to such data and information.

Arctic Tide Gauges

GOOS has determined a need for a global array of tide gauges, about 1000 km apart along all of the world's coastlines. In support of this, Canada will deploy up to four tide gauges in Canadian Arctic waters over the next four years. Potential sites include Nain (on the Labrador coast), Alert (on the northeast tip of Ellesmere Island), Pond Inlet (on the north tip of Baffin Island) and Cape Parry or Holman (both on the eastern side of the Beaufort Sea). The parameters measured will include sea level, atmospheric temperature, pressure, and relative humidity. GPS receivers are required alongside the Arctic gauges due to measurable crustal deformation expected in this region. The first year (2002) is being spent in determining the best locations for the gauges, accuracy requirements, gauging techniques to employ and testing of data gathering activities from the Nain gauge site. Later this year, the other specific sites will be chosen. Next year equipment will be purchased and installation will begin. Work on the data system will also commence. Subsequent years will complete installation and data system components.

Surface Underway Data

The project described last year for handling surface salinity data is considering broader dimensions. The new chair, Thierry Delcroix of France, will be conducting a meeting in Ottawa in September, 2002. This meeting will agree on a Project Plan and start to organize the data system required.

Data Issues

Canada is developing a relational database system to manage physical, chemical and biological data together. Most of the work on physical and parts of the biological components is complete with some tuning of the system still required. There is also the need to develop data manipulation modules to ease access to and handling of the data in the file.

Individuals from three different groups in Canada are working on a pilot project to test ideas for a marine XML. These ideas were discussed at the most recent IOC/ICES workshop and so support that international activity.

As explained in the discussions on Data Identification, MEDS as part of GTSPP, is working with BoM to implement a unique tag to be attached to all data flowing through the GTSPP.

National Report for France submitted By J. Picaut

The French contribution to oceanographic observations for climate includes the following components: voluntary observation ships (VOS), ships of opportunity (SOOP), tide gauges, drifting and anchored buoys and Argo floats. The French contribution to GODAE is clearly defined through the combined operational oceanography projects Mercator and Coriolis and the contribution to the Jason-1 satellite mission.

Meteo-France is installing its automatic BATOS system onboard a number of VOS. The contribution to the XBT international network is focused on the three tropical oceans, mostly through the IRD (Institut de Recherche pour le Developpement) centers. The XBT data are validated and archived at Sismer in Brest. IRD has also developed a thermosalinograph network onboard a dozen merchant ships. Three decades of sea surface salinity measurements in the tropical Pacific are available on the web at http://noumea.ird.nc/ECOP/siteecopfr/cdsss.htm.

These data are used for the preparation of the SMOS satellite mission.

The Hydrographic and Oceanographic Service of the French Navy (SHOM) is handling most of the French tide gauge network. Four tide gauges in the southern Indian Ocean and one in the Gulf of Guinea are handled by research groups under the ROSAME program.

Meteo-France regularly deploys drifting buoys as part of the Data Buoy Cooperation Panel (DBCP) and its two European and Indian Ocean sub-groups. It also contributes to the Surface Velocity Program (SVP).

During the Frontalis-1 cruise in April 2001, France helped maintain the US/Japan TAO/TRITON array by replacing an ADCP mooring at 0°-165°E and fixing several moorings along the 165°E meridian. The major contribution of France to the Tropical Moored Systems is through its contribution to the PIRATA array. A Memorandum of Understanding between Brazil, France and US was signed in Paris in August 2001 for a 5-year "consolidation phase" (2001-2005). Shiptime and vandalism are a continuous concern of the PIRATA array, and several persons in France are pushing for the construction of a dedicated vessel for maintaining PIRATA and deploying Argo floats in the tropical Atlantic.

The Mercator project is now into its operational phase. Since January 2001, weekly ocean analysis and prediction bulletins have been generated by the System Prototype (PSY1), which runs a three-dimensional model covering the North and Tropical Atlantic (1/3° resolution) and can integrate real-time satellite and in-situ data. The full range of Mercator products can be found on http://bulletin.mercator.com.fr. The year 2002 marks the start of "high-resolution" MERCATOR forecasting for European seas, with real-time routine modeling of the North and Mediterranean Seas at high resolution (1/15°). A global oceanic system with 2° resolution is under construction.
The Coriolis project is the in situ counterpart of Mercator. The establishment of an operational data center in Brest, constitutes the French contribution to a global in situ observing system. It sustains and improves the existing observing systems. It implements a new ocean network of profiling floats, as a contribution to Argo. Coriolis is thus one of the two Global Data Centers for Argo.

The French PROVOR floats are presently tested with FSI and Seabird salinity sensors. By fall 2002, a total of 40 PROVOR and 40 Apex floats will be deployed in the Atlantic as part of the European Gyroscope project. By 2003, France should provide a total of 250-275 floats for Argo.

National Report for Germany submitted by W. Zenk Version: 31-May-2002

Organisational Structure

The federal structure of Germany supports a diversity of ministries and universities involved in ocean observations for climate. Monitoring tasks are the responsibility of the Federal Maritime and Hydrographic Agency BSH in Hamburg. The 'Bundesamt für Seeschiffahrt und Hydrographie' is a Higher Federal Authority in Germany with responsibility for maritime matters. Its wide scope ranges from issues of economy in shipping to safety of ship's technology and marine research. BSH is an authority under the Federal Ministry of Transport, Building and

Housing.

Research tasks with occasionally applied subjects are frequently undertaken by a number of university institutions on a soft money or contract basis. Prime funding for pre-monitoring studies and experiments is provided by the Federal Ministry of Education and Research BMBF, the Federal Environment Ministry BMU and on a European level by the EC in Brussels.

Since OOPC VI (Melbourne 2-5 May 2001) the first national report on systematic climate observations was published by the Federal Republic of Germany. It was compiled by the national GCOS secretary at the Deutscher Wetter Dienst (DWD, National Weather Service). The oceanic part of this report was written by D. Kohnke with contributions from BSH, AWI, DWD and IfM Kiel and Hamburg. The report is available (in German)on the web at <http://www.dwd.de/research/klis/internat/gcos/d_nb-kbs.pdf >. It contains sections on VOS XBT lines, drifting and cycling buoys in the open ocean, tide gauges along the German North Sea coast, aerological observations with weather balloons on VOS and German research vessels (Automated Shipboard Aerological Programme, ASAP) and observation networks in marginal seas.
Point of contact: Dr. S. Rösner, DWD, Offenbach am Main

Ship of opportunity programme and dedicated sections
BSH continues to maintain two regularly sampled XBT lines on VOS in the Atlantic (Fig. Z1). The northern route at the edge of the subtropical gyre is served by the container ship "Bonn Express", the transequatorial line to Brazil by the "Kap Finistere". The data analysis concentrates on heat content fluctuations in the corridor between the Grand Banks and the entrance to the English Channel and on other XBT-routes with sufficient resolution. The 13- year-long time-series demonstrates a clear trend towards increasing heat content at the northern margin of the subtropical Atlantic along the North Atlantic Current regime. The warming trend is not restricted to the mixed layer but evident for the whole upper 750 m (A. Sy et al., Int. WOCE Letter, 26, 30–33, 1997). Funding of the XBT lines AX 3 and AX 11, i.e. NAC regime and the Europe - North Brazil route appears to be certain for 2002 – 2004.

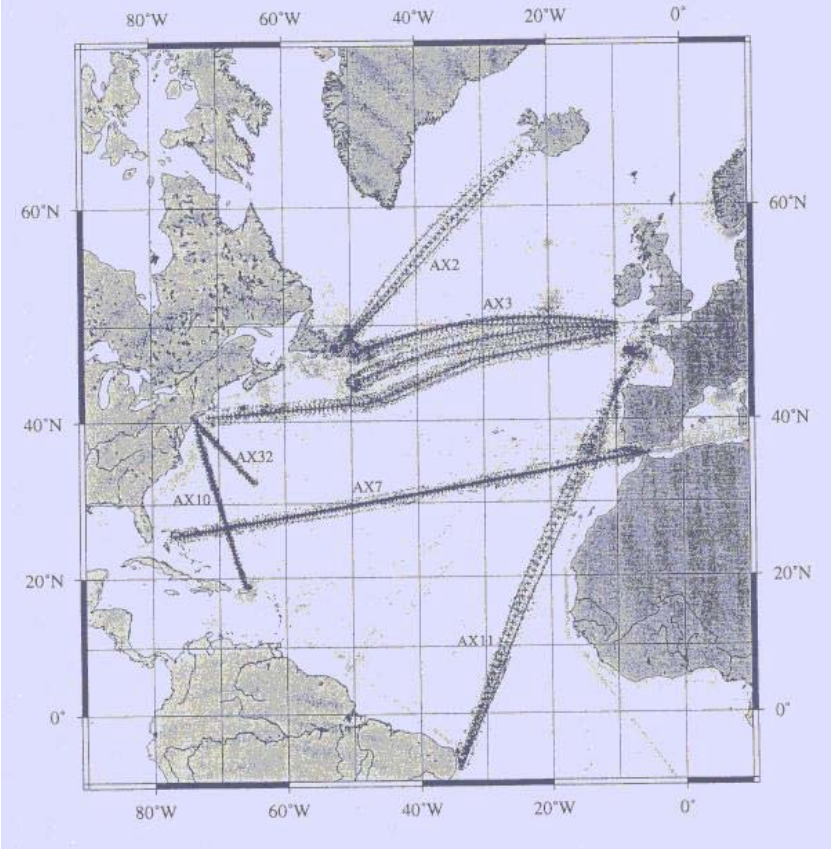


Fig. Z1: High density XBT lines in the North Atlantic. Lines AX 3 and AX 11 are served by BSH, Hamburg. (Fig. by A. Sy)

VOS lines of BSH are augmented by regular CTD sections along WOCE line A2 between the exit of the English Channel and Canada (Halifax or St. John's). These crossings with high-resolution station spacings started in 1956 and have been repeated ten times until 2002 . Further crossings are planned in 2-3 year intervals. The analysis aims at a determination of the relative importance of physical processes such as atmospheric forcing, advection, convection, entrainment. They all contribute to the thermohaline circulation on decadal time scales (K.P. Koltermann et al., Deep Sea-Research II, 46, 1o9-138, 1999). Of particular interest are climate relevant fluctuations of the meridional transport of the North Atlantic.
Point of contact: Dr. A. Sy and Dr. K. P. Koltermann, BSH, Hamburg

SST charts of marginal seas

Under the supervision of BSH in Hamburg and Rostock, weekly charts of surface temperature and other products (ice charts) from the North Sea and the Baltic are published on the internet. Thanks to the involvement of the Baltic Operational Oceanographic System (BOOS), a branch of EuroGOOS, the product-orientation, co-ordinationed and harmonisation of observation and information systems could be substantially improved.
Point of contact: with respect to all GOOS subjects: Dr. D. Kohnen, BSH, Hamburg

ARGO floats

At the national level, not much additional progress was achieved since the last two OOPC meetings in Bergen (2000) and Melbourne (2001). The research consortium of Alfred Wegener Institut in Bremerhaven, BSH Hamburg and IfM Kiel has been asked to reduce the original quantity of 150 APEX floats down to 108 for two years. Funds may be made available in the second half of 2002 with the obligation that not all cycling floats shall be bought from one manufacturer. The group agreed and will submit a revised proposal in the near future. It is planned to deploy this contingent in the Weddell Gyre, tropical Atlantic and in the wider region of WOCE section A2 (48°N) of the North Atlantic during 2003 – 2004 as a national contribution to ARGO in combination with specialised research interests of the involved PIs.
Points of contact: Dr. O. Boebel, AWI, Bremerhaven, Dr. K.P. Koltermann, BSH, Hamburg and Dr. J. Fischer, IfM, Kiel.

BSH continued to deploy APEX floats during 2002 in modest quantities (7) along the Mid-Atlantic Ridge at the northern extent of the North Atlantic subtropical gyre. Additional instruments which were bought from pure scientific funds have been made available by IfM Kiel in the subpolar gyre and the tropical regions of the central and western Atlantic (Fig. Z2). In accordance with the intrinsic Argo requirements all profiles from cycling German floats are available in real-time. The co-operation with the French CORIOLIS centre works excellently. This service handles all German float data that cycle on an Argo schedule. Data can be downloaded from their server in Brest without restrictions.
Point of contact: Dr. F. Schott and Dr. J. Fischer, IfM, Kiel

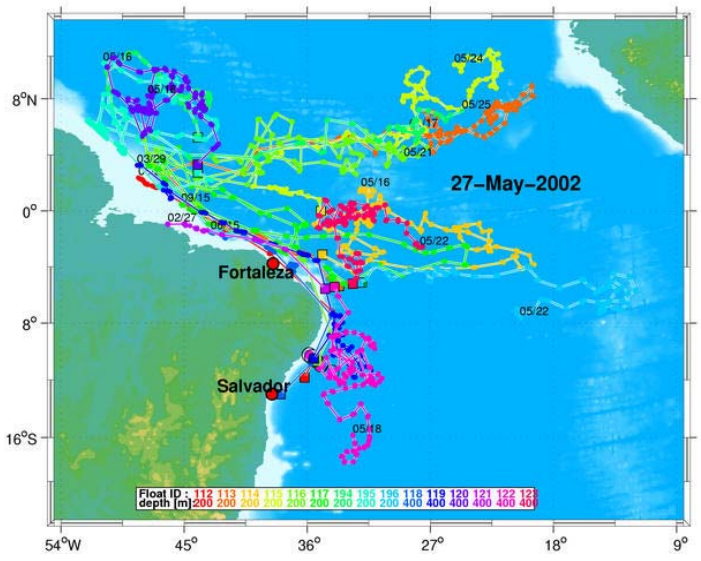


Fig. Z2: Trajectories collected by research APEX floats in the tropical Atlantic. Status: 27 May 2002. These data are freely available and contribute to the global ARGO network (Fig. by J. Fischer)

National Report for Japan submitted by Yutaka Michida, ORI/U.Tokyo

Argo

Japan is going to deploy 80-90 floats in Fiscal 2002 (Apr. 2002 - Mar. 2003) within the framework of the Japan-Argo programme. Almost all of them will be released in the North Pacific Ocean, except for 4 floats in the Indian Ocean. JAMSTEC (Japan Marine Science and Technology Center), which is a core institute of the Japan-Argo programme, has been coordinating national deployment of the profiling floats according to the discussion in the interagency working group for deployment. In addition to the vessels of JAMSTEC, vessels of Japan Meteorological Agency (JMA), Japan Coast Guard and Hokkaido University are participating in deploying the floats in this fiscal year. All the data are transmitted to the GTS. They are also available through the national data system. JMA operates a real-time data base and JAMSTEC a delayed-mode data base for the data of higher quality.

Tide Stations

There are more than 100 tidal stations on Japanese Islands. Ten of them, and one in the Japanese Antarctic Station, have been included in the GLOSS network. In response to the discussion in the last GLOSS meeting in Hawaii last year, four stations (Hamada, Toyama, Wakkanai and Abashiri) have also been included in the network since last year. The new stations are on the northern coast of Japan facing the Japan Sea or Okhotsk Sea.

The Antarctic Station, Syowa Station (39.6°E, 69.0°S), JARE (Japanese Antarctic Research Expedition) started tidal observations in 1966. A reliable sea level record has been obtained from 1981 to 2000 after correction of year-to-year variations of the reference level relative to the closest benchmark.

SAGE (Subarctic Gyre Experiment)

A national research project, SAGE (Subarctic Gyre Experiment), focusing upon the structure and variability of the subpolar gyre in the North Pacific was just finished in March 2002. The project will play an important role in understanding the overturning processes that form intermediate waters in the Pacific including NPIW, More than 30 research groups in physical, chemical and biological oceanography in Japan were involved in the project. Some of the results have already been published in scientific journals, and most of them will be published in Journal of Oceanography in 2003.

Data Issues

JODC (Japan Oceanographic Data Center), as the RNODC for WESTPAC, has initiated WESTPAC-GODAR a data rescue program in close cooperation with related Asian countries, aimed at improving the availability of oceanographic data in the WESTPAC region. To encourage the data exchange among scientists, a data inventory as a tool of data integration of Japanese chemical oceanographic data, was established in July, 2000 by a working group. The Inventory for Japanese Chemical Oceanographic Data (IJCD) is the name of the data inventory produced by the working group. The IJCD working group is comprised of 17 members from 13 research institutes in Japan. At present, the IJCD includes a total of 144 cruises with Japanese chemical oceanographic observations.

National Report for Norway submitted by J Johannessen

(Overview of ongoing and planned projects.)

Argo
Norway finally has joined the international Argo community. with 3 buoys purchased by the Institute of Marine Research. They were deployed in the central Norwegian Sea in week 22 (May 27-31). They have since been well tracked in the central basin of the Norwegian Sea.

Under a new PolarClimate research programme to be initiated towards the end of this year consideration is being given to submit a proposal for a national initiative to fund a Norwegian Argo project with 600,000 euros per year for several years leading to a possible deployment of 50 Argo buoys in the Norwegian-Greenland Seas.
Point of contact: Einar Svendsen, Institute of Marine Research, Bergen, Norway.

Moored Observing Systems
Svinøy Section. This section is deployed with current meter moorings to monitor the inflow of the two branches of Atlantic water entering the Norwegian Sea (Orvik et al., 2002). The section now constitutes a time-series that has been run for 7 years, 3-4 times a year. It is also monitored with repeat SeaSoar sections. The two branches, one representing the direct flow through the Faroe-Shetland Channel and one the branch coming in across the Iceland-Faroe Channel, appear not to merge but to continue northward as two separate branches.
Point of contact: Dr. Kjell Arild Orvik, Geophysical Institute, Univ. of Bergen.

Fareo-Shetland Channel. This measuring site is now in its sixth year and continues to provide important quantitative observations of the deep overflow based on moored upward-looking ADCPs. Its operation for the near future is ensured via the new EU supported project to start in September 2002. Note that the main goal of this project is to measure the water-mass exchanges across the UK-Greenland ridge, the Fram Strait and the Bear Is. –Tromsøflaket section.
Point of contact: Dr. Svein Østerhus, Geophysical Institute, UiB

Ocean Weather Station Mike The hydrographical data set from the Ocean Weather Station Mike (OWSM) extends back to 1948, and provides a time-series with daily to weekly resolution of temperature and salinity from the surface to the near bottom waters. The station is operated by the Norwegian Meteorological Institute and is given high priority in terms of continuity.
Point of contact: The Norwegian Meteorological Institute.

VOS – *NUKA ARCTICA*. The North Atlantic circulation study based on the on the VOS *NUKA ARCTICA* seeks to obtain a multi-year time-series of ocean currents and heat storage along a great circle path between the North Sea and Cape Farewell, Greenland. Such a time-series will elucidate the spatial and temporal variability of the currents in the top 200-400 m of the water column across the full span of the ocean, including the North Sea. An initial four-year program is being implemented to get a clear picture of the annual cycle and a measure of the interannual variability of the currents and heat fluxes. The variability of the fluxes and their sensitivity to the overlying atmospheric forcing, local and remote, is of fundamental climate interest.

The measurements are based an Acoustic Doppler Current Profiler (ADCP) that has been installed on the *NUKA ARCTICA*, a container vessel that operates between Denmark and Greenland on a three-week schedule. This instrument, which is being used very successfully on

other fast-moving vessels, measures upper ocean currents to an absolute accuracy of a few cm/s. Preparations are also underway to obtain Expendable Bathythermographs (XBTs) along some of the crossings so that the thermal structure of the top 1000 meters can be monitored. These data will make it possible to estimate the heat storage in the upper ocean and to examine the poleward heat transport by the large scale flow. The role played by the energetic meso-scale eddy field therein can also be assessed.
Point of contact: Dr. Thomas Rossby, University of Rhode Island, USA and Dr. Svein Østerhus, Geophysical. Institute, University of Bergen, Norway. Other partner institutes include: Faroese Fisheries Laboratories, Faroe Islands, UMR, Toulouse, France, Danish Meteorological Institute, Denmark, Stockholm University, Sweden

Repeat Sections. The Institute of Marine Research has for several decades carried out repeat sections 3-4 times a year at various locations along the coast of Norway from the North Sea in the south to the Barents Sea in the north. The sections, which extend from the coastal planes across the shelf break into deep water, provide CTD casts and, in recent years, ADCP measurements as well. This sampling program will continue to provide data for the future.
Point of contact: Einar Svendsen, Institute of Marine Research, Bergen, Norway.

Modeling
Bergen Climate Model/NERSC Model. The coupled atmosphere-ocean-sea ice climate model is global with a resolution of 150 km in the far field to 20-40 km in the near field of the North Atlantic.
Point of contact. Dr. Helge Drange, Nansen Center, Bergen.

National Report for the UK submitted by Peter K Taylor

The UK contributions to Ocean Observing Systems include participation in the following programmes (See also Report on European Projects provided below) .

Argo
The UK contribution to Argo is managed and coordinated by the Met Office. Funding is being provided by DEFRA (the government Department for the Environment Food and Rural Affairs) and the Ministry of Defence, together with a substantial in-kind contribution (e.g. float deployment from research vessels, data archiving) from the Natural Environment Research Council. The project also involves Southampton Oceanography Centre (SOC), the British Oceanographic Data Centre (BODC) and the UK Hydrographic Office. The aim is to establish by March 2003 an operational system with the capacity to deploy about 50 floats each year, thus maintaining about 150 to 200 UK Argo floats in the water at any one time. All Argo data will be captured in real time in support of operational ocean forecasting, as well as the processing of UK float data in delayed mode for climatological and hydrographic purposes.
The geographical areas of UK interest are the North Atlantic, Norwegian Sea, South Atlantic, South Indian Ocean, Arabian Sea and Southern Ocean. The present position (at end May 2002) of UK and other floats is shown in Figure 1. The UK British Oceanographic Data Centre (BODC) acts as the delayed mode archive centre for all UK deployed floats and is establishing an international Argo regional delayed mode data centre for the Southern Ocean. Data are available on-line from BODC.

A phase II project to 2006 has been proposed in order to sustain the UK contribution to Argo, the phase II project will focus on demonstration of benefits from Argo as part of the justification for the UK providing longer-term funding for an operational Argo float array.

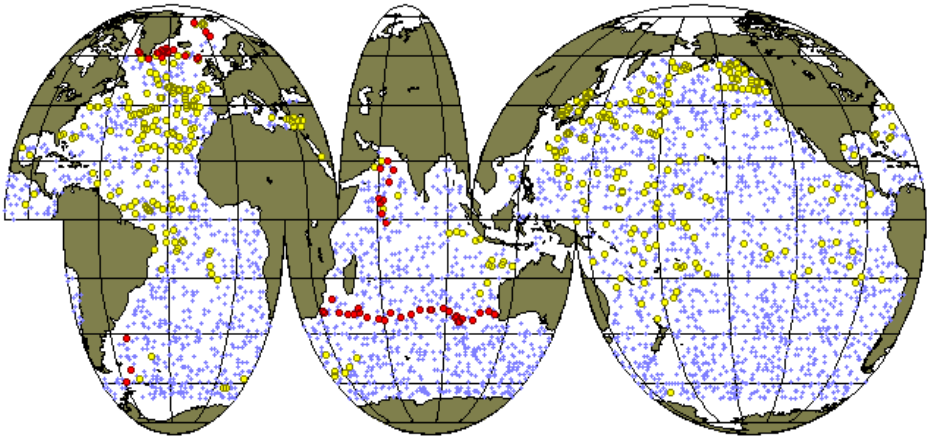


Figure 1. Map showing positions (at end of May, 2002) of UK floats (dark circles), other floats (light circles), and the proposed full array (grey crosses). A daily updated version of this map is available at the SOC website (see below).

Links: Met Office: http://www.meto.gov.uk/research/ocean/argo
BODC: http://www.bodc.ac.uk/projects/argo.html
SOC: http://www.soc.soton.ac.uk/JRD/HYDRO/argo/index.php

EGOS

The Met. Office is a participant in the European Group on Ocean Stations (EGOS) and contributes to the drifting buoy program (Figure 2) as well as maintaining moored meteorological buoys around the UK coast (Figure 3). Recent developments include trials of acoustic methods of rainfall measurement (in collaboration with SOC). Buoys in the North Sea are maintained by CEFAS (The Centre for Environment, Fisheries and Aquaculture Science).

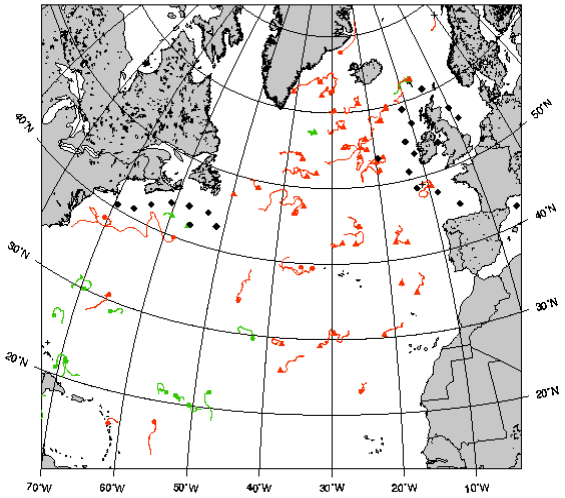


Figure 2. EGOS drifting buoy trajectories during April, 2002 (from http://www.meteo.shom.fr/egos/traject/traject.htm)

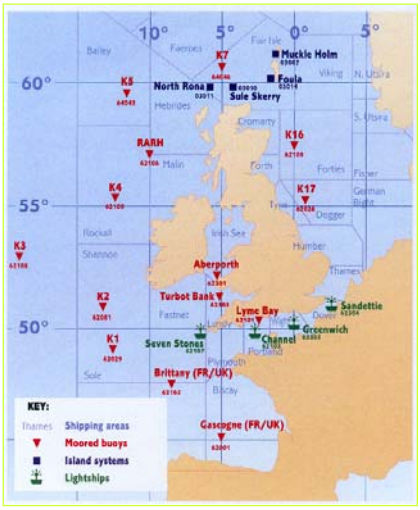


Figure 3. Moored buoy positions around the UK coast
(courtesy the Met Office)

VOSClim

As well as participating in the WMO Voluntary Observing Ships (VOS) programme the Met Office is playing a major role in the VOS Climate Project (VOSClim). It is acting as the VOSClim Real-Time Monitoring Centre and has provided the VOSClim project manager (Sarah North). It is also one of the most active participants with regard to ship recruitment. The SOC is providing scientific guidance for the VOSClim project and hosted the third project meeting in January, 2002. More information on VOSClim is included under "Air-Sea Fluxes.

Links: http://www.ncdc.noaa.gov/VOSClim.html

Report on European Projects contributed by W. Zenk, J. Johannessen and P.Taylor

GYROSCOPE

The objectives of this EC-funded project can be categorized as follows.

Technical issues

- Deploy 80 profiling floats in the NE Atlantic as part of the global ARGO project.
- Collect, validate and distribute their data freely through the Coriolis Data Service.

Analytical issues

- Estimate the scientific information content, complementary to satellite altimetry.
- Develop products for real-time ocean state estimates by inverse and objective mappings and assimilation techniques
- Estimate scales of ocean transport and structure variability

Formulation of recommendations for future applications

The project started in 2001. The funding period lasts 3 years. Involved in the consortium are ten laboratories from France, Germany, Spain and the UK. The consortium published its first annual report in February 2002 and held its annual meeting in Madrid in May 2002. By the end of summer 2002 all floats will be purchased, tested and deployed in the Atlantic between Iceland and the Canary Islands. So far, all work packages are on track. Due to the scientific demands of Gyroscope its float population will supersede the ARGO requirements (3 x 3 degrees). Fig. G1 shows the status in May 2002 of all cycling floats, the vast majority being equipped with CTD sensors for vertical profiles of temperature and salinity. All Gyroscope floats drift at 1500 m depths. Before ascending they dive down to 2000 m, thus delivering profiles from the abyssal up to the sea surface. In accordance with the ARGO science team they cycle on a ten-day mission.

Point of contact: Dr. Y. Desaubies, Ifremer, Brest

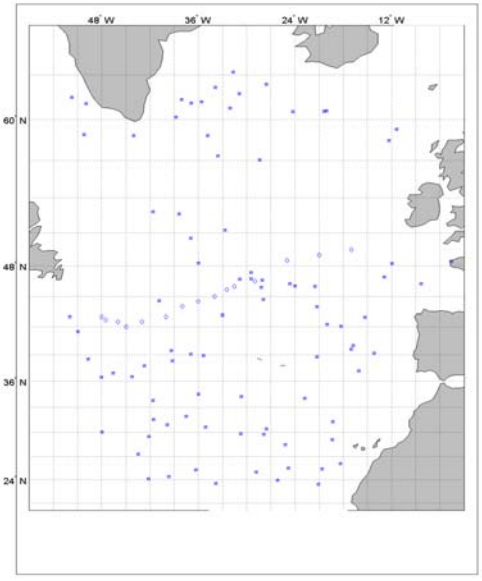


Fig. G1: Distribution of cycling ARGO floats in the North Atlantic. Nominally the ARGO Science Team asked for 1 float per 3 x 3 degree box. Due to topographic effects (i.e. Rockall Plateau) and dispersion the distribution is heavily biased. By July 2002 the entrance to the Labrador Sea is expected to show an increased population. Status: 26 May 2002, Source: CORIOLIS, Brest

ANIMATE

The **A**tlantic **N**etwork of **I**nterdisciplinary **M**oorings **a**nd **T**ime-Series for **E**urope started in December 2001. It is funded by the EC Partners under the co-ordination of IfM Kiel, coming from laboratories in Germany, Iceland, Spain and the UK. The project provides an initial network of interdisciplinary moorings equipped with physical (current, CTD, light) and chemical sensor packages (pCO2, nutrients). Target regions for time-series stations are deep water locations in:

- the eastern extent of the subtropical gyre – (ESTOC north of the Canary Islands complementary to BATS in the western Atlantic),
- Porcupine Abyssal Plain (PAP, a former JGOFS location) and
- in the subpolar gyre – CIS (Central Irminger Sea).

All moorings have surface buoys with on-line telemetry for a reduced data set from about 10 sensors between 10 and 1000 m depth. Site service is planned every 6 – 12 months. An extended transmission is planned for reduced ADCP (upward looking) data from 150 m depth and the pCO2 sensors during year 2 of the project.

The field work in ANIMATE started in April 2002 with FS METEOR at ESTOC. Unfortunately, the telemetering buoy broke loose after a few weeks. It was later rescued with the assistance of Spanish authorities. Additional deployments are planned in August (CIS) and September (PAP) 2002.

Point of contact: Dr. U. Send, IfM, Kiel

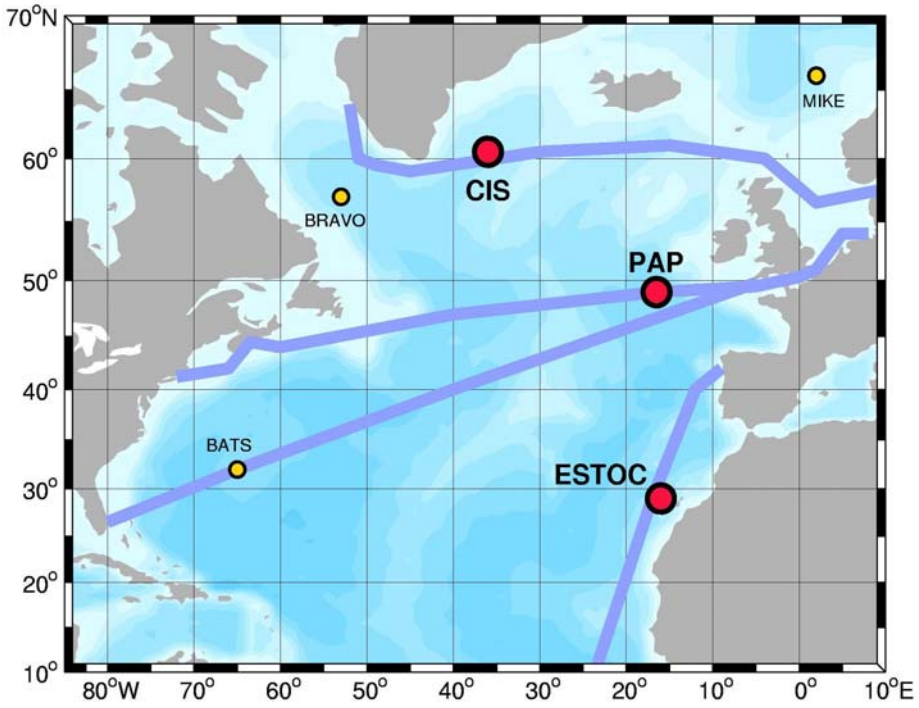


Fig. A1: Location of ANIMATE moorings ESTOC, PAP and CIS embedded in the network of XBT lines and the European CO_2 programme CAVASOO (Carbon Variability Studies by Ships of Opportunity).

MERSEA Strand-1: A Global Monitoring for Environment and Security (GMES) Projet
This is an international EU funded project with 20 European partners which will enter into phase 1 in October 2002. The MERSEA Strand-1 builds on the following motivation. In spite of the considerable advances in the integration of numerical models and observing systems, their provision of information products to support the assessment of the state of European marine environments and ecosystems is currently fragmented, regionally inconsistent and very often incomplete. Until this deficiency and its causes are properly documented, it will not be feasible to identify the important knowledge gaps, that, in turn should be prioritised and filled via targeted research and monitoring as stated in the GMES call. In this context the goal of MERSEA Strand-1 project will consequently be to analyse the strength and weaknesses with existing European operational oceanography and data assimilation systems, in particular regarding a) modelling capabilities; and b) data observations, integration and data flow. Four data assimilation system will be used, notably: TOPAZ, MERCATOR, FOAM and MFS. EU aims to have GMES fully implemented and operational by 2008. The European Space Agency (ESA) collaborates with EU in the GMES program with particular emphasize on the space and ground segment as well as operational services. ESA will release an Invitation to Tender (ITT) in September 2002.

In parallel with this, an international consortium named MERSEA (for Marine EnviRonment and Security for the European Area) is under establishment that will bid for Global Operational Oceanography under the EU FP6/Large-scale Integrated Project (LIP) call to be closed at the end of the year. MERSEA aims to develop a European capacity for operational monitoring and forecasting of ocean physics, biochemistry and ecosystems on global and regional scales. One may consider this to be Europe´s consolidated contribution to GODAE. Each LIP project will typically last for 3-5 years at a total budget of 30-50 million euros.
Points of contact: MERSEA Strand-1: Dr. Johnny A. Johannessen, Nansen Center;
MERSEA - LIP : Dr. Jean-Francois Minster, IFREMER, Paris

In addition to these initiatives there are other LIPs that are more directly focused on the global and regional climate change. These include (not exclusive): GloMEaSy (Global Monitoring of the Earth System), a Consortium led by Dr. A. Hollingsworth, ECMWF, and CARE (Climate of the Arctic and the Role for Europe) a Consortium led by Prof. O. M. Johannessen, Nansen Center and Prof. J. Thiede, AWI.

UK participation in European Projects submitted by P.Taylor
UK scientists are participating in a number of European projects aimed at developing ocean observing systems; a number of are to be be discussed elsewhere during the OOPC meeting. They include "Animate" (Atlantic Network of Interdisciplinary Moorings and Time-series for Europe) in which SOC is a partner; "Cavassoo" (CArbon VAriability Studies by Ships Of Opportunity) which is coordinated from the School of Environmental Sciences, University of East Anglia; and "Ferry Box" with participation from SOC and Chelsea instruments.

Links: Animate: http://www.soc.soton.ac.uk/animate/main/home.html
Cavassoo: http://envsol.env.uea.ac.uk/temp/tracer/e072/

Ferry Box: http://www.soc.soton.ac.uk/GDD/Sonus/concept.htm

Hydrographic lines

Hydrographic lines which are being occupied at least annually by SOC are the Drake Passage and the "Ellett" line between Scotland and Iceland.

Links: Drake Passage: http://www.soc.soton.ac.uk/JRD/HYDRO/scu/dp/
Ellett: http://www.soc.soton.ac.uk/GDD/hydro/nph/rockall/rockall.html

Programmes under development

A research programme to monitor the Atlantic meridional overturning circulation has funding of £20M over 6 years and is expected to create a monitoring array at around 24°N. A British contribution to the Dynamics of Earth and Ocean Systems (B-DEOS) is also in the planning stage.

Links: Atlantic: http://www.nerc.ac.uk/funding/thematics/rcc/
B-DEOS: http://www.ocean.cf.ac.uk/DEOS

ANNEX XIV

SUMMARY OF ACTION ITEMS

Action No.	Report Ref.	Action Description and Responsible Person(s)
1	1.	Need nominations to GSC to replace Smith and Zenk. (Harrison, Hood)
2	3.1	A second OceanObs99 Conference for an update (perhaps with JCOMM) should be considered at OOPC-VIII. (OOPC, Hood)
3	3.1	Improve OOPC interactions with PICES and ICES. (Harrison, Keeley)
4	3.1	Strengthen ties with operational sea-ice activities. (Reynolds)
5	3.2.1	Assist with 2nd Adequacy report. (Smith, Harrison)
6	3.2.2	Increase OOPC's attention to polar issues. (Harrison)
7	3.2.4	AOPC requests made to the SST/Sea Ice Working Group. (Reynolds)
8	3.3	Review COOP's Strategic Design Plan. (Dickey, Johannessen, Weller, Zenk, Keeley)
9	3.3	Participate in next COOP meeting. (Dickey, Harrison)
10	3.3.2	Make National Reports available to B. Thompson (Alexiou, Hood)
11	3.4	Assist WCRP in forming a group to push for specific satellite observations. (Johannessen)
12	3.5	Develop items for POGO meeting scheduled 22 Jan 2003, Hobart. (Weller, Harrison)
13	3.5	Increase OOPC Travel budget to reflect increasing coordination demands.. (Hood)
14	4.2	Pass OOPC thoughts on Tropical Mooring Review to managers (Harrison)
15	4.3	Send letter to JSC and CLIVAR SSG re air-sea fluxes importance. (Harrison, Taylor)
16	4.4	Remind JCOMM and other met groups of importance of VOSClim. (Harrison and Taylor)
17	4.5	Develop items for CLIVAR reanalysis workshop (Harrison, Michida and Reynolds)

18	4.6	Develop outline for a state-of-the-ocean report based on indices.(Harrison, Reynolds)
19	4.7	Vasily Smolyanitsky and/or Nick Rayner attend OOPC-VIII. (Reynolds, Hood)
20	4.8	Letter to Kamel Puri (WGNE) emphasizing OOPC's undiluted interest in SURFA. (Weller, Harison)
21	4.10.1 & 8.	Prepare a paper outlining a CO_2 pilot project. (Dickey et al).
22	5.2	Consider OOPC-VII comments in organizing the South Atlantic Workshop. (Campos)
23	6.3	Review ToR to accommodate CLIVAR Ocean Basin Reps at OOPC meetings. (Harrison, Hood)
24	6.3.1	OOPC VIII agenda should address CLIVAR reanalysis workshop. (Harrison, Hood)
25	6.3.2	Offer assistance to CLIVAR SSG on data management. (Keeley, Smith)
26	8.	Draft a strategy document for sea ice. (To be decided)

ANNEX XV

LIST OF ACRONYMS

ACSYS	Arctic Climate System Study
ACVE	Atlantic Climate Variability Experiment
ADCP	Acoustic Doppler Current Profiler
ADEOS	Advanced Earth Observing Satellite (Japan)
ALACE	Autonomous Lagrangian Circulation Explorer
ANIMATE	Atlantic Network of Interdisciplinary Moorings and Time-Series for Europe
AOML	Atlantic Oceanographic and Meteorological Lab (NOAA)
AOPC	Atmospheric Observing Panel for Climate
Argo	profiling fleet network (not an acronym)
ASCAT	Advanced Scatterometer
ATOC	Acoustic Thermometry of Ocean Climate
ATSR	Along Track Scanning Radiometer
AUV	Autonomous Underwater Vehicle
AVHRR	Advanced Very High Resolution Radiometer
BC	Boundary Current
BECS	Basin-Wide Extended Climate Study
BMRC	Bureau of Meteorology Research Center (Australia)
BODC	British Oceanographic Data Center
BSH	Bundesamt fur Seerschiffahrt and Hydrographie (Germany)
CAS	Commission for Atmospheric Sciences
CAVASOO	Carbon Variaibility Studies by Ships of Opportunity
CDS	Computerized Documentation System
CLIC	Climate and Cryosphere
CEOS	Committee for Earth Observation Satellites
CGOM	IOC Consultative Group on Ocean Mapping
CLIMAT	Report of Monthly Means and Totals from Land Stations
CLIVAR	Climate Variability and Predictability Program
CMR	Centre Meteorologico Regional
CNES	Centre National d'Etudes Spatiales (France)
CRYOSAT	Ice Observing Satellite (ESA)
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
CTD	Conductivity, Temperature, Depth
DAC	Data Assembly Centre
DM	Data Management
DODS	Distributed Ocean Data System
ECMWF	European Center for Medium-Range Weather Forecasting
EEZ	Exclusive Economic Zone
ENSO	El Nino Southern Oscillation
ENVISAT	Environmental Satellite
EOS	Earth Observation Satellite (US)
ERS	Earth Resources Satellite
ESA	European Space Agency
ESD	Earth Sciences Division
EUMETSAT	European Organization for Exploitation of Meteorological Satellites
FNMOC	Fleet Numerical Meteorology and Oceanography Center (US NAVY)
GCOS	Global Climate Observing System
GDACS	Global Data Assembly Centres
GEBCO	General Bathymetric Chart of the Oceans
GEF	Global Environmental Facility

GEO	Global Eulerian Observing System
GEOSAT	Geodetic Satellite (US)
GEWEX	Global Energy and Water Cycle Experiment
GLAS	Goddard Laboratory of Atmospheric Sciences (US)
GLI	Global Imager
GMT	Greenwich Mean Time
GOCE	Gravity field and steady state Ocean Circulation Experiment
GODAE	Global Ocean Data Assimilation Experiment
GOOS	Global Ocean Observing System
COP	Conference of the Parties (to the UN FCCC)
GOSIC	Global Observation System Information Center
GOSSP	Global Observing Systems Space Panel
GPCP	Global Precipitation Climate Project
GPO	GCOS Project Office
GPS	Global Positioning System
GRACE	Gravity Recovery and Climate Experiment
GSC	GOOS Steering Committee
GTS	Global Telecommunications System
GTSPP	Global Temperature Salinity Profile Program
GUAN	Global Upper Air Network
G3OS	Shorthand for GOOS, GCOS, GTOS
HDX	High Density XBT Line
HOTO	Health of the Ocean Panel (of GOOS)
HOTS	Hawaii Ocean Time Series Station
IBCCA	International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
IBCEA	International Bathymetric Chart of the Central Atlantic
IBCM	Int'l Bathymetric Chart of the Mediterranean
IBCWIO	International Bathymetric Chart of the Western Indian Ocean
ICESAT	Ice Satellite (NASA)
ICPO	International CLIVAR Project Office
IGOS	Integrated Global Observing Strategy
IGOSS	Integrated Global Ocean Services System
IGST	International GODAE Science Team
IHB	International Hydrographic Bureau
IHO	International Hydrographic Organization
IMO	International Maritime Organization
IOC	Intergovernmental Oceanographic Commission
IOCCG	International Ocean Color Coordinating Group
IOOS	Integrated Ocean Observing System (US)
IP	Implementation Plan
IPCC	Intergovernmental Panel on Climate Change
IR	Infrared
ISRO	Indian Satellite Research Organization
JAMSTEC	Japan Marine Science and Technology Centre
JCOMM	Joint Technical Commission On Oceanography and Marine Meteorology
JDIMP	Joint Data and Information Management Panel
JGOFS	Joint Global Ocean Fluxes Study
JMA	Japan Meteorological Agency
JSTC	Joint Scientific and Technical Committee
KERFIX	Kerguelan Time series Station
LMR	GOOS Living Marine Resources Panel
MERIS	Medium Resolution Imaging Spectrometer
METOP	Meteorological Operational Satellite
MJO	Madden-Julian Oscillation

MOC	Meridional Overturning Circulation
NAO	North Atlantic Oscillation
NASDA	National Japanese Space Development Agency
NCDC	National Climatic Data Centre
NCEP	National Center for Environmental Prediction (US)
NEG	Numerical Experimentation Group
NIWA	National Institute of Water and Atmospheric Research (New Zealand)
NOAA	National Oceanic and Atmospheric Administration (US)
NPOESS	National Polar-Orbiting Operational Environmental Satellite System (US)
NPP	NPOESS Preparatory Program
NSCATT	NASA Scatterometer
NWP	Numerical Weather Prediction
OCTS	Ocean Color and Temperature Scanner
OGCM	Ocean General Circulation Model
OGP	Office of Global Programs (US)
OOP	Ocean Observations Panel
OOPC	GOOS-GCOS-WCRP Ocean Observations Panel for Climate
OOS	Ocean Observing System
OSSE	Observing System Simulation Experiment
PBECS	Pacific BECS
PICES	Pacific ICES
PDO	Pacific Decadal Oscillation
PIRATA	Pilot Research Array in the Tropical Atlantic
PMEL	Pacific Marine Environmental Laboratory (of NOAA)
PMO	Port Meteorological Officer
POGO	Partnership for Observations of the Global Oceans
PRA	Principle Research Area (of CLIVAR)
QC	Quality Control
QSCAT	Version of Scatterometer
RMS	Root Mean Square
SAFZ	Sub-Arctic Frontal Zone
SBSTA	Subsidiary Body for Scientific and Technological Advice {of the COP for the UNFCCC}
SCOR	Scientific Committee for Oceanic Research
SIO	Scripps Institution of Oceanography
SLP	Sea Level Pressure
SMOS	Soil Moisture Ocean Salinity Satellite (ESA)
SOC	Southampton Oceanography Centre
SOC	Specialized Oceanographic Centre
SOCIO	Sustained Observations for Climate of the Indian Ocean
SOCSA	Sustained Observations for Climate for the South Atlantic
SOOP	Ship-of-Opportunity Programme
SSIWG	Salinity - Sea Ice Working Group
SSS	Sea Surface Salinity
SST	Sea Surface Temperature
SURFA	Surface Reference Sites Project
TAO	Tropical Atmosphere - Ocean (buoy array)
TEMA	Training Education and Mutual Assistance
TRITON	Japanese Moored Buoy in TMBN
TRMM	Tropical Rainfall Measuring Mission
TS	Temperature Salinity
UKMO	UK Met Office
UNFCCC	United Nations Framework Convention on Climate Change
UOP	Upper Ocean Panel

UOT	Upper Ocean Thermal
VAMOS	Variability of the American Monsoon Systems
VIIRS	Visible and Infra-red Sensor (NPOESS Sensor)
VOS	Voluntary Observing Ship
WBC	Western Boundary Current
WCRP	World Climate Research Program
WDB	WMO Data Base
WGASF	Working Group on Air-Sea Fluxes
WGNE	Working Group on Numerical Experimentation
WGSIP	Working Group on Seasonal to Interannual Predication
WHOI	Woods Hole Oceanographic Institution
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WS	Workshop
XBT	Expendable Bathythermograph
XCTD	Expendable Conductivity Temperature Depth Instrument