OBSERVATIONS PROGRAMME AREA COORDINATION GROUP (OCG) FIRST SESSION

La Jolla, CA, USA, 24-27 April 2002

FINAL REPORT

JCOMM Meeting Report No. 13

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

OBSERVATIONS PROGRAMME AREA COORDINATION GROUP (OCG) FIRST SESSION

La Jolla, CA, USA 24-27 April 2002

FINAL REPORT

JCOMM Meeting Report No. 13

N O T E

C O N T E N T S

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. Opening of the session

1.1 Opening

1.1.1 The first session of the JCOMM Observations Coordination Group (OCG-I) was opened by the chairman of the group, and Observations Programme Area (PA) Coordinator, Dr Stan Wilson, at 0900 hours on Wednesday, 24 April 2002, in the Martin Johnson House Conference Centre of the Scripps Institution of Oceanography (SIO), La Jolla, California, USA. Dr Wilson welcomed participants to the meeting, and expressed his appreciation to SIO, and in particular to Dr Dean Roemmich, for hosting the meeting and providing such excellent facilities and support. He then called on the Director of the SIO, Dr Charles Kennel, to address the group.

1.1.2 Dr Kennel welcomed participants to the meeting and to Scripps. He noted that the implementation of a global ocean observing system required extensive and strong partnerships. In this context, oceanographic institutes such as Scripps have a lot to offer this process, including basic scientific expertise, instrument development, logistics support, quality assurance, and the development of analysis and forecast techniques. Argo provides a good model of such partnerships, but there remained many additional challenges, and it was necessary to develop specific targets, as a focus for all countries. Dr Kennel stressed that the first incremental steps were now being made in transforming ocean science and applications: these were now moving beyond comprehension to a continuous awareness of earth system processes, which would provide the input necessary for good global environmental management. He concluded by wishing everyone a successful meeting and an enjoyable stay in La Jolla.

1.1.3 The co-president of JCOMM, Dr Savi Narayanan, reiterated the appropriateness of this first meeting of the Observations Coordination Group taking place at Scripps, and offered her thanks to Dr Kennel for hosting the meeting. She welcomed all participants, on behalf of the Commission, and wished them a very successful meeting.

1.1.4 Dr Wilson then outlined the role and objectives of both the group in general and the present meeting in particular. He expressed the view that the primary objective was to facilitate development of the JCOMM integration process with regard to the in situ observing system, to ensure that the different components worked effectively together in addressing stated requirements. This included integration with satellite observations, as well as the development of integrated system performance metrics, to quantitatively assess how well the requirements were being met. A further elaboration of the major issues and goals for the meeting is given under agenda item 2.1.

1.1.5 The list of participants in the meeting is given in *Annex I*.

1.2 Adoption of the agenda

1.2.1 The group adopted its agenda for the session on the basis of the provisional agenda, with some small modifications. This agenda is in *Annex II*.

1.3 Working arrangements

1.3.1 The group agreed to its hours of work and other relevant working arrangements. The documentation was introduced by the Secretariat.

2. Reports

2.1 Chairman and Secretariat

Report of the chairman

2.1.1 The group noted with appreciation a report by the chairman on his activities in support of the work of the group and of the implementation of the Observations Programme Area work plan generally. This report specifically addressed the priority issues to be covered during the present session. Essentially, these issues are structured along the following lines:

(i) For each of the component systems and panels: system rationale, desired coverage, status, major issues, costs and funding, users and feedback;

(ii) Cross-cutting issues such as vandalism, maximizing data availability, QA/QC, capacity building, JCOMMOPS, funding, performance metrics, non-physical data;

(iii) Desired overall system, including optimal mix of components and cost/benefits;

(iv) Tailored performance metrics showing system performance versus observational data requirements.

An outline of this report is given in *Annex III*.

Report of the Secretariat

2.1.2 The group recalled that JCOMM was formally established in 1999 by Thirteenth Congress (WMO) and the Twentieth Session of the IOC Assembly, through a merger of the Commission for Marine Meteorology (CMM) and the Joint IOC/WMO Committee for IGOSS. JCOMM is the reporting and coordinating mechanism for all operational marine activities in both WMO and IOC. As such, it is charged with the international coordination, regulation and management of an integrated, operational, oceanographic observing, data management and services system which will eventually become the ocean equivalent of the World Weather Watch.

2.1.3 The first session of JCOMM took place in Akureyri, Iceland, from 19 to 29 June 2001. The session was attended by 113 participants from 42 Members/Member States and 11 international organizations. A summary report of the main results of the session of relevance to the OCG is given in *Annex IV*.

2.1.4 The group was informed that the JCOMM Management Committee had held its first session in Geneva in February 2002. Among the many issues addressed, those of interest to the OCG included:

(i) A thorough review of the Programme Area work plans and implementation strategies;

(ii) The appointment of Dr Hiroshi Kawamura as satellite rapporteur and Dr Tony Knap as rapporteur on non-physical variables and JCOMM;

(iii) The identification of integration and overarching issues for JCOMM, and the development of an overall strategy;

2.1.5 The group noted all these developments with interest, and agreed that they provided an appropriate framework and overall objectives for its own work, both during the coming week and in the future.

2.1.6 The group further noted with appreciation the various actions taken by the JCOMM Secretariat in support of the Commission, and in particular the Observations Programme Area, since JCOMM-I. Members of the group were urged to:

(i) Visit the UN Atlas of the Oceans (http://www.oceansatlas.org/) once it was formally opened to the public on 5 June 2002, and offer comments and suggestions as appropriate regarding its enhancement within the context of JCOMM and its work;

(ii) Also visit the new JCOMM web portal being hosted by IOC (http://www.jcomm.net/), provide comments and suggestions as appropriate, and also make use of the portal as a means for information exchange in support of JCOMM;

(iii) Provide the Secretariat with suggestions regarding a JCOMM logo. (**Actions**: Group members and Secretariat)

2.2 Component teams and rapporteurs

2.2.1 The chairs of the Observations PA component teams (Ship Observations Team (SOT), Data Buoy Cooperation Panel (DBCP), Tropical Moored Buoy Implementation Panel (TIP), Argo Science Team, Global Sea-Level Observing System (GLOSS) Group of Experts), as well as the satellite rapporteur and the JCOMM *in situ* Observing Platform Support Centre (JCOMMOPS) Coordinator, presented reports to the meeting. These reports focused on the status of the component observing systems and recent work in the respective areas, and specifically addressed issues such as: system rationale and review; system definition and assessment; major issues in system implementation; observed parameters, data applications and user feedback.

Ship Observations Team

2.2.2 The chairman of the Ship Observations Team (SOT), Rick Bailey, recalled that the SOT manages a group of very successful, long enduring data collection programmes, involving voluntary observing vessels and ships-of-opportunity, which have supported a number of research and operational applications over many years. At present there are over 5000 vessels collecting globally surface meteorological observations. Subsets of these also collect upper air meteorological and upper ocean physical data. Programmes for surface biogeochemical observations are being developed. The challenge for SOT is to maintain, coordinate, and integrate wherever possible these programmes to support the range of presently defined operational and research applications, by meeting a number of specified scientific goals to an agreed upon level of performance. It plans to achieve this utilizing the most efficient technologies, whilst complementing related observing systems in an environment of competition for resources, taking into consideration national objectives. A web site is being developed for the overall ship observations programme. Web sites are also available for several of the component programmes, which can all be accessed through JCOMMOPS (http://www.jcommops.org/). Full details of these programmes, including rationale and status may be obtained from these web sites.

2.2.3 The individual programmes presently support research, climate forecasting, numerical weather prediction and maritime safety services amongst other applications. The requirements for ocean state estimation applications are rapidly growing. The sampling rationale has been set via the various scientific advisory groups, including the Ocean Observations Panel for Climate (OOPC), the Atmospheric Observations Panel for Climate (AOPC), and the CLIVAR Ocean Observations Panel (COOP). The global upper ocean thermal sampling network (XBT SOOP) was recently scientifically reviewed as part of an on-going review of the elements. A revised implementation plan is being acted upon for that network.

2.2.4 The SOT met for the first time in Goa, India, 25 February to 2 March 2002. Approximately 50 people attended, from 20 countries, representing 5 or more programmes. Information was exchanged and discussed on the status and future plans for each programme. General issues for JCOMM include the need for programmes of instrument evaluation and certification; proposed review of TORs for the SOT and its panels; capacity building in remote areas to help identify, select and maintain vessels in the volatile shipping environment; insufficient resources to implement the programmes adequately (e.g. only 24,000 XBTs of the required 35,000 XBTs, more automatic weather stations on VOSClim ships, more radiosondes); connections and feedback on data quality and coverage from climate services that are external to JCOMM in addition to the marine services internal to JCOMM; review of the overall requirements for ship observations programme coordination and monitoring and the potential role for JCOMMOPS in supporting VOS and ASAP as well as SOOP activities. The SOT established three Task Teams to address issues relating to instrument evaluation, programme promotion and JCOMMOPS development.

2.2.5 The group expressed its appreciation to Mr Bailey for his report. It considered that the SOT constituted an excellent first step in enhancing integration in operational ocean observing systems, in improving efficiencies and cost-effectiveness, and generally in improving data delivery to users. Specific issues identified included:

(i) The importance of an overall strategy for ensuring the global availability of all observational data from VOS/SOOP, both in real time and delayed mode. The work of the GTSPP constitutes a significant component of this strategy;

(ii) The potentially valuable role of POGO in stressing the value in sharing data, to facilitate access to research vessel data and in capacity building;

(iii) The problem that funding for XBT networks is still largely research-based.

Data Buoy Cooperation Panel

2.2.6 The Chairman of the DBCP, Graeme Brough, presented a report on behalf of the Panel. He explained that the DBCP provides a forum for all matters related to management of the various international buoy networks and deployments (drifting buoys and moored buoys in the high seas). In particular, the DBCP undertakes many tasks orientated towards ensuring integrated data processing operations, appropriate data quality, the robustness of the international exchange of buoy data, and the maximization of meteorological data on the GTS. The DBCP is an integral part of the observations programme under JCOMM, and supports the implementation of many other international programmes such as WWW, WCRP, CLIVAR, GOOS and GCOS. DBCP now reports to JCOMM and participates in the JCOMM OCG. To achieve its goals, the DBCP particularly established regional Acton Groups and is served by a Technical Coordinator. The Panel's Technical Coordinator function has provided the core for the recently launched JCOMMOPS facility. DBCP maintains a web site at http://www.dbcp.nos.noaa.gov/dbcp/.

2.2.7 In recognition of the Panel's responsibilities with respect to the implementation of the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS), as well as the on-going support it provides to the WWW and the WCRP, the Panel undertook the development of a DBCP Implementation Strategy in 1997. The purpose of the strategy is to provide an overall framework and focus for the Panel's work. The DBCP is, of course, primarily a coordination body and takes its observational data requirements from other responsible bodies. The Panel's Implementation Strategy in particular recognizes requirements from sources such as the First International Conference on an Ocean Observing System for Climate (OceanObs 99); JCOMM-I references; the WMO World Weather Watch; and the Final Report of the Ocean Observing System Development Panel (OOSDP), 1995, and related follow-up documents from the OOPC.

2.2.8 Graeme Brough explained that the DBCP can now be considered a relatively mature organization. Over the years the Panel has transitioned from a small group of people interested in buoy data, to an organization that now has a very stable constituent base, and has well established practices and procedures in place. The DBCP is prepared to share its experiences and methods of operation with the broader marine community, to assist in the general adoption of appropriate methodologies for the future. With regard to specific integrated observing system issues:

(i) **System rationale**: The DBCP Implementation Strategy is based on, and attempts to satisfy to the extent possible, requirements for ocean data to support operational meteorology (the WWW) and global climate studies (GOOS/GCOS/WCRP through the OOPC). At the same time, it must be recognized that a significant component of the overall buoy network consists of buoys funded by and deployed in support of specific research projects.

(ii) **System assessment**: System performance metrics with regard to WWW requirements are prepared for the Panel by Météo France, and can be accessed through the JCOMMOPS/DBCP web site. These are used by the Panel and its action groups in developing tactical and strategic deployment campaigns. It is hoped that similar metrics with regard to observational data requirements for climate will also be available shortly.

(iii) **Major issues in implementation**: One of the major challenges facing the Panel and buoy operators is to provide an effective forum to maintain the buoy networks established for research programmes and assist in their conversion into long-term operational programmes. In this regard, funding, including long term funding for the Technical Coordinator's position, remains an issue of concern.

(iv) **Data applications and user feedback**: The Panel actively encourages and supports operational impact studies for buoy data. The Panel conducts an on-going dialogue with both operational and research data users, in particular through the annual scientific and technical workshops.

Tropical Moored Buoy Implementation Panel

2.2.9 The Chairman of the Tropical Moored Buoy Implementation Panel (TIP), Mike McPhaden, provided an overview of the status of the tropical moored buoy array in all three ocean basins and of the work of the TIP (see summary in *Annex V*). Tropical moored buoy arrays provide an essential element of the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS). Detailed implementation issues are overseen by the TIP co-sponsored by GOOS, GCOS, and CLIVAR. A major activity of the TIP over the past year was to participate in the review, sponsored by the Ocean Observations Panel for Climate (OOPC) and the CLIVAR Ocean Observations Panel (COOP), of tropical moored buoy programmes in support of climate research and forecasting. A workshop was held at the NOAA Pacific Marine Environmental Laboratory in Seattle, Washington during 10-12 September 2001. A final report of the workshop is under review.

2.2.10 With regard to specific ocean basins, the status may be summarized as:

Pacific Ocean

The TAO/TRITON array in the Pacific continues to effectively serve a wide community of scientists involved in seasonal-to-interannual climate research and forecasting. The availability of data in real-time, its high quality, and its widespread dissemination via the GTS and the World Wide Web are hallmarks of TAO/TRITON. The data from this array underpins recent forecasts issued by NCEP and the WMO of developing warm conditions in the tropical Pacific for 2002. There is a reasonably stable base of resources at present in terms of funding, ship time, personnel for TAO/TRITON.

Peru received World Bank funding to acquire and deploy surface SeaWatch moored buoys made by Oceanor as part of a programme called NAYLAMP. Ecuador has recently received funding for purchase of three Oceanor moored buoys. These buoys will be used to maintain two sites, one at 2°S, 85°W and one at 2°S, 89°W. Like the Peruvian buoys, the Ecuador buoys will extend the TAO/TRITON array to near the coast of South America. First deployments are planned for May 2002. Spearheaded by Chilean scientists, plans have been drawn up for an extensive programme of moorings spanning the west coast of South America between 5°N and 45°S.

Atlantic Ocean

The same technology (ATLAS moorings) and data processing schemes are used for the French, Brazilian, USA PIRATA array in the Atlantic. The array of 10 moorings was begun in 1997 and so does not yet have the track record that TAO/TRITON does in supporting research and forecasting efforts. However, many research groups are using the data in modelling and empirical studies of tropical Atlantic phenomenology and in studies of how the ocean affects climate in this region.

Indian Ocean

As yet there is nothing approaching a full moored array in the Indian Ocean. There are several interrelated science drivers for developing an Indian Ocean moored buoy programme in support of climate (e.g. the monsoons, Indian Ocean Dipole, intra-seasonal variability, etc) and efforts are underway to establish an initial moored buoy network for climate studies in the region. These efforts include two JAMSTEC TRITON buoys and the buoys of the Indian National Data Buoy Programme in the Arabian Sea, Bay of Bengal and along the equator. India maintains five deep sea moored buoys and five coastal moored buoys, all measuring surface pressure, air temperature, winds, SST, SSS, waves and surface currents. It also has two equatorial current metre moorings.

Argo Science Team

2.2.11 Dean Roemmich reported on Argo. The fourth meeting of the international Argo Science Team (AST-4) was held in Hobart, Tasmania, Australia, from 12-14 March 2002. International commitments to the Argo project continue to increase. More than 10% of Argo has now been deployed, with about 400 floats active in April 2002. The number of active floats will increase rapidly over the coming year - over 1500 floats have now been funded, with additional proposals over the next three years averaging nearly 900 floats per year. In consideration of the steep increase in float deployments, AST-4 considered areas needing attention for successful large-scale Argo implementation. These include completion of the data management system, technical aspects of float performance, a regional float deployment planning mechanism, and the need to demonstrate the utility 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.

2.2.12 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 centres (GDACs) will occur well before the end of 2002. Argo profiles are presently being distributed on the GTS and distributed via the Internet by the IFREMER/Coriolis GDAC. An improved user interface is being implemented at Coriolis and a second GDAC will soon be operating. Plans for scientific quality control of Argo data were discussed – including a semi-automated step as described by the PMEL centre, and final examination by the principal investigator. It was agreed that, by September 2002, the scientifically reviewed Argo data should start becoming available.

2.2.13 Technical issues relevant to the Argo array were reviewed. A major development is the availability later this year of the Iridium system for improved communication bandwidth, two-way capability, and decreased surface time for Argo floats. Continuing successes with stable salinity sensors were also 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.

2.2.14 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 centres 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.

2.2.15 The complete AST-4 Report is available from the AST web site http://www.argo.ucsd.edu. Current status of Argo can be obtained from the Argo information Centre at http://argo.jcommops.org.

Global Sea Level Observing System Group of Experts

2.2.16 Gary Mitchum, on behalf of the chairman of the GLOSS Group of Experts, reported on the status of GLOSS. The GLOSS Core Network (GCN) consists of 287 tide gauge stations (as of the 1997 GLOSS Implementation Plan), although this number may change slightly once the most recent review of the implementation plan is completed in 2002. The GCN comprises three distinct, but slightly overlapping, station subsets. These three subsets are for the purpose of studying long-term trends (LTT), for calibrating satellite altimeters (ALT), and for monitoring key ocean circulation indices (OC). These three subsets are discussed in detail in the GLOSS Implementation Plan.

2.2.17 At present, approximately two thirds of the GCN is operational, as measured by data return to the Permanent Service for Mean Sea Level. Progress has been made in recent years in the provision of more timely data, and in the provision of high frequency (i.e. hourly) data, but work remains to be done in both of these areas. The plan for GLOSS explicitly takes satellite altimetry into account in order to insure complementarity, and it may be noted that the GLOSS-ALT subset is now an integral part of satellite altimetric operations.

2.2.18 Two major needs are identified at present. Two major areas of improvement are required for GLOSS. First, several geographic regions are very under-represented, and funds for new and replacement gauges are badly needed. Funds are also needed for the training of local gauge operators and to provide local installation costs in some cases. In addition, in many areas upgrades to allow the provision of more timely data are required. Second, in particular for the ALT and LTT subsets, absolute geodetic positioning (using continuous GPS or DORIS, for example) is essential, as is the provision of more timely data. In the long-term, it is desirable that all GLOSS sites have such positioning, but the immediate priority is at the ALT and LTT sites. Further information may be obtained from the GLOSS web site (http://www.pol.ac.uk/psmsl/programmes/gloss.info.html)

2.2.19 The group agreed that improvements were needed to make the system fully operational, under the assumption that satellite altimetry measurements will be available for the foreseeable future:

(i) *altimetry calibration and long-term trends*: the fast-delivery (hourly) sub-set of some 100 sites was sufficient for calibrating the satellite altimetry measurements and determining long-term trends. However, there remained a need to measure land movements. To that end, an additional 100 sites should be equipped with GPS/DORIS systems;

(ii) *monitoring oceanic circulation:* tide gauges were needed to monitor narrow straits where altimetry was not possible. In addition, the installation of a GLOSS gauge along a coast would provide the coastal country with an example of how it could develop its own network. There was a requirement for a few dozen gauges and the associated training of local technicians.

2.2.20 The group recognized that JCOMM was in a good position to assist with the capacity building component of the GLOSS programme (see item 6.2 below). It further recognized that the question of consumables was a critical one in some countries and that any assistance provided should include a long term commitment in this field on the part of the donors.

Satellite Rapporteur

2.2.21 Hiroshi Kawamura, the JCOMM satellite rapporteur, presented a report on the present status of global satellite ocean observations. Satellite remote sensing has become a mature technology for measurements of ocean parameters such as Sea Surface Temperature (SST), Sea Ice, Surface Vector Wind, Surface Waves, Sea Surface Heights (SSH) and Chlorophyll-a (Chl-a) for the global oceans, with high temporal/spatial resolution. The meteorological operational satellite system was established at around the beginning of the nineteen eighties. In contrast research and development (R&D) of ocean-dedicated satellites and sensors has been conducted in the nineties, and some of them are ready to become operational.

2.2.22 At present, a considerable number of the operational and R&D satellites for observation of the ocean are or soon will be in space. Most of them are well proven to be oceanographic tools, while some of them address technological challenges to measure new parameters. Real-time delivery of the proven satellite products is demanded by some operational agencies. In order to conduct a demonstration of operational oceanography, GODAE is now developing high-resolution SST, integrating several satellite SST products through a new approach. Experience over the past decade has clearly demonstrated that space based observations are most useful when used in conjunction with complementary *in situ* data.

2.2.23 The group recognized that the key issue regarding satellite observations was the transition from R & D to operational programmes, for which there would be an assurance of long-term funding. Surface topography and surface vector wind measurements were examples of such R & D programmes for which there was as yet no assurance regarding long-term continuation. To address that problem, there was a need to maintain a dialogue with satellite operators, if possible through existing mechanisms such as IGOS or the “High Level Interaction” developed by WMO as a supplement to its operational satellite activities to involve R & D satellite programmes for current meteorological purposes In this context, it recognized the onus on JCOMM to make clear statements to satellite operators regarding the requirement for long-term continuity of ocean satellite observations of proven quality and operational/research value. (**Action**: Satellite rapporteur, co-presidents and Secretariat.)

2.2.24 The group also agreed that, as far as the JCOMM Observations Programme Area was concerned, the main issue remained to develop *in situ* observing systems to complement satellite observations as much as possible, including for calibration purposes.

JCOMMOPS

2.2.25 Etienne Charpentier reported on JCOMMOPS and its establishment. He recalled that the concept for a JCOMM *in situ* Observing Platform Support Centre (JCOMMOPS) was first introduced and discussed at the second transition planning meeting for JCOMM, Paris, June 2000. Since the DBCP and SOOP were initially providing the resources to run JCOMMOPS through the DBCP and SOOP international coordination facilities, it was then also discussed and approved by the DBCP and SOOP. Finally, at its first session, Akureyri, Iceland, 19-29 June 2001, the Commission strongly endorsed the concept of JCOMMOPS and adopted a recommendation for its adoption as a formal JCOMM centre. JCOMMOPS, which is run by the DBCP and SOOP Coordinator, also includes the Argo Information Centre and the Argo Coordinator, Mr. Mathieu Belbéoch.

2.2.26 JCOMMOPS basically provides support and coordination at the international level for implementation and operational aspects of observational programmes run by the DBCP, SOOP, and Argo (i.e. XBTs, drifting buoys, moored buoys on the high seas, and sub-surface profiling floats). This is a two-person centre based in Toulouse, France. It is one of the areas where JCOMM integration is being achieved.

2.2.27 Support from JCOMMOPS is provided through a number of means. These include: (i) provision of status information regarding observational programmes (e.g. status maps, lists of operational platforms), (ii) provision of information on data requirements (e.g. GOOS, GCOS, WWW), (iii) assistance with the development of cooperative arrangements for buoys and sub-surface float deployments, and for the servicing of moored buoys in the high seas, (iv) assistance as appropriate in relaying quality information from data users back to data producers, (v) assistance as appropriate in the standardization of data formats, (vi) provision of information regarding satellite data telecommunication systems (e.g. survey by David Meldrum, vice-chairman, DBCP), (vii) assistance in promoting GTS distribution of the data, (viii) monitoring, and (ix) links to appropriate products and services developed and made available elsewhere.

2.2.28 To provide those services, a common, integrated DBCP, SOOP, and Argo relational database was designed, built, and connected to a dynamic web based system, which also includes a Geographical Information System (GIS). The database is in the process of being loaded with relevant programme information. It particularly already includes a copy of a subset of GTS data (excluding geophysical sensor data) provided by Météo France to JCOMMOPS on a monthly basis (i.e. SHIP, TEMP-SHIP, BUOY, BATHY, TESAC, TRACKOB).

2.2.29 From the activities of JCOMMOPS the following goals are eventually expected to be achieved: (i) facilitate the decision making process by programme managers, (ii) facilitate programme implementation at the international level, (iii) facilitate operational and monitoring aspects, and (iv) information on instrument suppliers and instrument quality evaluation.

2.2.30 The first session of the JCOMM Ship Observations Team (SOT-I) (Goa, 25 February to 2 March 2002) reviewed in detail the present activities of JCOMMOPS, as well as possibilities for its future development. The SOT meeting noted that substantial support is already being provided by JCOMMOPS to ship based observing systems, mainly for the SOOP programme, but also for the VOS programme to a lesser extent (e.g. information on ship logistical opportunities, lists of contact points). The SOT meeting noted, however, that the support provided to the VOS and ASAP programmes was minimal at the moment, due to the lack of resources to develop and manage such support. It recognized at the same time the potential value of JCOMMOPS providing similar support to those two programmes as it is already provided to the DBCP and SOOP. It also agreed that JCOMMOPS had a potentially very valuable role to play in the JCOMM integration process, in providing a single source of integrated information on the status of the overall system. JCOMMOPS could also act as a single portal to a range of distributed information and data centres related to SOT, such as the VOSClim Data Assembly Centre (DAC) and the WMO ship catalogue. At the same time, the SOT meeting recognized that a review of the SOT coordination and monitoring procedures and responsibilities was required, before consideration could be given to estimating and identifying the resources needed for JCOMMOPS development. The review should include a specification of requirements (in particular for VOS and ASAP under JCOMMOPS, together with the integration aspects), plus an implementation plan to achieve full operational status. The SOT meeting therefore established a small Task Team on JCOMMOPS, comprising the chairs of the SOOP, VOS and ASAP Panels and the JCOMMOPS Coordinator, chaired by the SOT chair, to develop this plan. The plan should be available within six months, for circulation to SOT members for review, prior to its consideration by the Observations Coordination Group, and eventually by the JCOMM Management Committee at its second session in early 2003. The group agreed with the strategy adopted by the SOT.

2.2.31 The SOT chair, together with the SOOP chair, the Secretariat and the JCOMMOPS Coordinator had discussed the issue in conjunction with the OCG-I meeting. They suggested that a number of services might be offered for SOT coordination in the near future, using existing resources, either at JCOMMOPS or at specific agencies in Member States (e.g. QC feedback for VOS, SOT web page, information on telecommunication systems, SOT logo). Other services, however, which needed additional resources to be developed, were identified (e.g. brochure, VOS web site). The group agreed with these suggestions and recommended to take them in to account when drafting the SOT coordination plan by the task team.

3. Requirements and interactions

3.1 Summaries of requirements for ocean data, or observed parameters, in support of different themes—operational meteorology and oceanography, numerical weather prediction and climate monitoring research and prediction (based on the results of OceanObs99)—were presented to the meeting for review and discussion.

Operational Meteorology and Oceanography, NWP

3.2 The group noted that the WMO Secretariat maintains, on behalf of all WMO programmes, those of IOC and the Committee on Earth Observation Satellites (CEOS), a comprehensive data base of observational data requirements for the different programme areas, including, *inter alia*, NWP, operational meteorology, marine services, and climate prediction. This database is currently being used by CBS as part of its major project to re-design and rationalize the Global Observing System (GOS), a process to which JCOMM is contributing substantially regarding the marine component. In addition, the data base is used as a resource for developing "Statements of Guidance" on how well the composite observing system meets the observational data requirements of a number of application areas, such as marine services.

3.3 *Annex VI* contains extracts from this database giving summaries of the requirements for observational data, including ocean data, in support of, respectively, JCOMM/GOOS, nowcasting and NWP. The group agreed that these stated requirements should be taken into account when assessing the status and capabilities of the existing operational ocean observing system.

3.4 The group noted with appreciation that the JCOMM satellite rapporteur, Dr Hiroshi Kawamura, and the JCOMMOPS coordinator, Mr Etienne Charpentier, participated as JCOMM representatives in the fourth session of the CBS Expert Team on Observational Data Requirements and the Redesign of the GOS (Geneva, 28 January to 1 February 2002). Within the context of this meeting, they prepared a first draft of a Statement of Guidance relating to the marine component of the GOS and JCOMM requirements for marine observational data. As noted by Dr Kawamura and Mr Charpentier, this draft now needs extensive review, both within JCOMM (the Services and Observations CGs) and outside (GOOS/COOP and GODAE).

3.5 This statement was reviewed by the recent first session of the JCOMM Management Committee (Geneva, 6-9 February 2002). It recognized that the statement should be consistent with the Oceans Theme document of the IGOS Partners, and that it might serve to identify deficiencies in both this document and also the WMO/CEOS requirements database. The draft was also provided to the first session of the Services Coordination Group (Geneva, 3-6 April 2002), which will undertake a detailed review as the draft becomes more developed. In addition, the SCG has put in place a mechanism to review and update the WMO/CEOS database (*VI*), specifically with respect to the observational data requirements for marine meteorological and oceanographic services. (**Action**: SCG.)

3.6 The group noted these requirements, and agreed that, after further review, they should form part of the overall observational data requirements to be addressed by the component teams as well as by the Data Management Coordination Group. (**Action**: Team chairs.)

Climate

3.7 On behalf of the Ocean Observations Panel for Climate (OOPC), Ed Harrison provided an update on OOPC activities and highlights of those areas where the OOPC had identified issues arising for JCOMM. The key issues for the OOPC had not changed significantly since JCOMM-I. Priorities included the implementation of GODAE and Argo; the development of a global ocean time series observatories system; the transition of the Ship-of-Opportunity programme, including incorporation of non-physical measurements; the implementation of VOSClim; and the maximization of data quality, especially for sea level pressure (SLP) and SST. The OOPC had established Expert Groups on both SST and SLP. In addition, to meet the needs of the users of an integrated ocean observing system, the OOPC was developing a product, product skill and product improvement focus. This involved emphasis on the quantity and quality of individual observations, appropriate global data distribution, and product skill evaluation to guide implementation choices and priorities. For JCOMM, the OOPC believed that the overall priority should remain the implementation of the requirements expressed in the report of OceanObs99. In this context, JCOMM and OOPC should work together to develop the optimum mix of sensors and data relative to each region, in order to reach product skill goals. A summary of this report is in *Annex VII*.

3.8 During the ensuing discussion, the major points addressed included:

(i) The need to consider global observations of boundary currents, where small autonomous underwater vehicles (gliders) may be the only cost-effective technology for global coverage;

(ii) While there is a growing awareness at government level within some countries of the need for sustained, systematic ocean observations, in particular for climate predictions, this awareness is still to be translated into enhanced funding support for such observations;

(iii) GODAE may be able to assist data providers, by working with the users to demonstrate the practical value of operational products, though such a demonstration requires the further development and refinement of these products.

Office of Global Programmes/NOAA

3.9 Mike Johnson, OGP, reported that NOAA is embarking on a multi-year implementation plan to work with international partners to complete an initial global ocean observing system for climate. Although the primary driver is improved climate services, a secondary benefit will be improved marine services. The plan is based on the concept of extending the building blocks that have been put in place by the JCOMM panels and international research programmes, and on the international plan drafted by over 300 scientists from 26 nations that met in Saint Raphael, France, October 1999, at the OceanObs99 Conference. International partnerships are essential to success. He stressed that a global observing system by definition crosses international boundaries and the potential exists for both benefits and burdens to be shared by many nations. In this regard, NOAA is committed to working with the JCOMM OCG, implementation panels, and the OOPC, to refine planning and implementation, in concert with other nations' interests in contributing to a global ocean observing system.

3.10 Recognizing that the observing system will evolve as knowledge increases, an initial set of objectives and milestones has been defined to guide a phased implementation over the next ten years. The objectives are meant to respond to the long-term observational requirements of the operational forecast centres, international research programmes, and major scientific assessments. The initial milestones provide realistic targets while at the same time providing flexibility for evolution of the design as technology improves and the patterns of climate variability become clearer.

3.11 The overall global system is a composite of complementary networks, both in-situ and space-based, all internationally coordinated. Each network brings its unique strengths and limitations; together they build the whole. The initial milestones for the in situ networks include:

- Deploy an array of 1250 drifting buoys for sea surface temperature, pressure, and current measurement, by 2005.

- Deploy an array of 3000 Argo floats for upper ocean temperature and salinity profiling, by 2004.

- Deploy 90 tropical moorings for measurements of the ocean, atmosphere, and ocean/atmosphere exchanges, by 2007.

- Establish 86 tide gauges for altimeter drift calibration and documenting long term trends in sea level change, by 2006.

- Establish 29 ocean reference station moorings to provide a sparse network of high accuracy calibration points and fixed sites for documenting long term trends in the ocean, by 2007.

- Occupy 41 ship-of-opportunity lines for high accuracy upper ocean, surface meteorological and multi-disciplinary observations, by 2007.

In addition to the in situ networks, the system depends on a continuing operational constellation of satellites for measurement of sea surface temperature, sea surface height, and surface vector winds. The full report is given in *Annex VIII*.

3.12 The group expressed its appreciation to Mr Johnson, and to NOAA, both for the presentation and the overall system concept, and also for the major contribution which NOAA was making to its implementation. It agreed that the system concept as presented provided an excellent basis for an overall JCOMM system overview, to be addressed under agenda item 4.

Partnership for Observation of the Global Ocean (POGO)

3.13 Shubha Sathyendranath, Executive Director POGO, reported that the Partnership is a recently-formed organization that brings together major oceanographic institutions of the world interested in large-scale ocean observations. It has a strong mandate for capacity building. Several activities were launched in 2001. In collaboration with IOC and SCOR, POGO has set up a Visiting Fellowship Programme. It is designed to provide training opportunities to scientists and technicians from developing countries. Furthermore, POGO participates in, and co-sponsors, training courses and outreach activities, jointly with other organizations with shared interests.

3.14 POGO supports the Argo Programme, and a Time Series Initiative (jointly with OOPC and CLIVAR). It has also initiated some efforts to promote biological observations. A POGO workshop on biological observations was held in 2001, and another workshop on marine bio-diversity is to be held in October 2002 (jointly with CoML). The regional focus of the bio-diversity meeting will be the waters around South America. POGO has also been encouraging enhanced ocean observations in under-sampled regions such as the Southern Hemisphere. POGO has a News and Information Group that helps with promotion and dissemination of POGO activities. POGO also has an interest in addressing issues related to data management and distribution.

3.15 The group agreed that POGO and JCOMM share common interests in capacity building, in data management and exchange, in promotion of ocean observations, and in coordination of efforts in this area. It therefore agreed that continued close contact should be made between JCOMM and POGO, through the Management Committee and also the Observations, Data Management and Capacity Building Programme Areas. (**Action**: PA chairs and Secretariat)

Non-physical variables

3.16 The group appreciated Stephen Weisberg, on behalf of the JCOMM rapporteur on non-physical data, Tony Knap, introducing prospects for emerging chemical and biological observations (see summary in *Annex IX*). Given the importance of moving in this direction, as well as a result of this presentation, the group requested Tony Knap to prepare a brief report to the second session of the JCOMM Management Committee (MAN-II) outlining specific next steps for moving JCOMM in this direction. (**Action**: Tony Knap)

4. Observing system overview

4.1 Based on the reports reviewed under agenda item 2, and in particular the cross-cutting issues addressed in these reports (system rationale and review; system definition and assessment; major issues in system implementation; observed parameters, data applications and user feedback), the group developed an overview of the operational observing system coordinated under JCOMM. This may be summarized as:

A. Rationale for the overall system

(i) Supporting and improving understanding of and the ability to forecast:

- Decadal and long-term climate change
- Sea level variability
- Seasonal to interannual climate variability

(ii) Support for and continuation to improvements in:

- Numerical weather prediction
- Numerical ocean prediction
- Provision of marine services

B. Required improvements in the overall system

(i) SOT

(a) Enhance HRX/FRX lines (requires 35,000 vice 24,000 XBTs) and develop associated multi-disciplinary capabilities;
(b) Implement VOSClim with 200 ships;
(c) Add additional Southern Hemisphere ASAP units.

(ii) DBCP

(a) 50% increase in SST buoys, all buoys with barometers;
(b) Enhance ice buoy deployments in accordance with implementation plan.

(iii) TIP

Extend the tropical buoy array into the Indian Ocean.

(iv) GLOSS

(a) the GLOSS core network from the present Establish absolute positions for the remaining 60 of 100 GLOSS stations needed for altimeter calibration and long-term trends;
(b) Complete 180 to 270.

(v) Argo

Complete implementation of the 3000 float array.

(vi) Satellites

Long-term commitment for altimetry and scatterometry.

(vii) Time series observations

Increase number of flux sites, observatories, transport sites.

5. Integrated performance metrics and mapping

5.1 As a direct output from the overview undertaken under the previous agenda item, the group considered the development of integrated system performance metrics, to be presented in the form of system maps or related graphics involving both component observing systems and observed parameters.

Existing metrics

5.2 The group noted that a variety of different system performance metrics existed already, developed by and in support of the various system components. These directly supported system operators, and might generally be classified as:

(i) Monitoring the number of funded/deployed units as a function of agreed goals;
(ii) Monitoring data return;
(iii) Monitoring data availability as a function of requirements for specific variables.

The group recognized the value of such metrics, particularly as management tools. At the same time, it agreed that additional metrics were required, in particular to display overall system performance in some relatively simple way, as a means of presenting this performance in the context of generating support and funding for required enhancements.

Integrated metrics

5.3 The group agreed that, for such an overall display, it required a standard base map, for those requirements which could be displayed in this way, which would show:

(i) For each requirement, an overlay giving what is required against what is in place;
(ii) Gaps in coverage;
(iii) Subsets by country.

5.4 The group agreed on the following immediate actions towards achieving its integrated metrics requirements:

(i) A single access point would be provided through JCOMMOPS to the existing individual system component monitoring results**. (Action**: JCOMMOPS Coordinator and component chairs to provide relevant access information.)

(ii) A first draft of an integrated system performance monitoring scheme to be developed by the JCOMMOPS coordinator and MEDS. (**Action**: Coordinator, OCG chair and Bob Keeley.)

(iii) This draft will then be distributed to the OCG chair and the chairs of the component teams for their review and input, prior to implementation. (**Action**: OCG and team chairs, Secretariat)

6. Additional crosscutting issues

Vandalism

6.1 Examples of vandalism had been experienced by the Tropical Moored Buoy Implementation Panel (see *Annex V*), as well as by developing moored buoy projects such as those along the west coast of South America or around India. Several remedial measures have been tried, including information through various kinds of pamphlets and brochures, education of local people potentially concerned, actions taken at the level of intergovernmental organizations such as IOC or IHO, etc., all with the same lack of success.

6.2 New initiatives were being undertaken by JAMSTEC, which consisted of suppressing most of the mooring superstructures and replacing them by a small buoy equipped with an antenna, but little success was expected. The primary problem was that the moorings were very effective fish aggregators and fishing fleets, local or coming from abroad, would inevitably locate and exploit these aggregations, with little concern for the scientific devices attached to the moorings.

6.3 The group agreed that, given the present situation, the only workable approach to such vandalism was: (i) if possible, and if the acts of vandalism were not too important and frequent, to budget for equipment loss and replace it as needed; (ii) if the situation was too difficult, to try and find an alternative measuring technique and abandon the idea of a mooring in that specific location.

Capacity building

6.4 The group reviewed the various capacity building activities undertaken under a number of its component groups, as follows:

GLOSS

6.5 Centralized training courses may not be always the ideal solution to capacity building, since there is never an assurance that the right people would attend the course. Priority should be given to training one or more individuals who would take care of gauges locally, in order that they feel responsible of the fate of the gauge. Since those devices do not imply a sophisticated technology, this is generally easy to realize. In addition, the training should be closely focussed on what will be expected from the trainees. To learn how to use the gauge data locally to predict tides and for other local applications will build a sense of ownership.

TIP

6.6 Deploying high seas moorings is a very complex exercise, which implies that the country aiming at acquiring that technology has to devote a considerable amount of effort and funding to reach the stage of being fully independent. When successful, that exercise constitutes in general a good contribution to all the community concerned.

Argo

6.7 The construction of profiling floats involves highly sophisticated technologies. Some countries nevertheless have expressed their intention to reach that capacity, with the technical assistance of others. A challenge for Argo is the provision of this technical assistance.

DBCP

6.8 Together with SIO, the DBCP has published an SVP construction manual which has proved to be useful for some countries in manufacturing Lagrangian drifters. Another project is now to try and attract oceanographers or meteorologists of developing countries in the region the DBCP sessions are held, to help them to become familiarized with data buoys and their use for scientific and operational purposes.

SOT

6.9 The essential capacity building effort in this field is that undertaken by WMO to train Port Meteorological Officers. As was noted for the GLOSS training courses, there is a need for careful follow up to those training exercises if their effectiveness is to be ensured. The question of more sophisticated training of PMOs to allow them to cope with oceanographic measurements is to be considered in the near future.

6.10 The group agreed that information regarding all its capacity building activities should be passed to the Capacity Building Coordination Group for consideration at its forthcoming first session and incorporation into an overall JCOMM capacity building programme. (Geneva, June 2002). (**Action**: Secretariat)

Real-time data dissemination

6.11 The group reviewed two possibilities for improving real-time data dissemination:

(i) To get data from research ships (surface meteorological, upper ocean temperature, salinity and currents): real-time dissemination of such data was not considered to be a high priority by scientists. Some action could be envisaged on the part of POGO and the directors of participating institutions to make the real time transmission of such data routine to research vessel operators; (**Action**: SOT and POGO)

(ii) To get part of the (roughly) 40% of drifting buoy data that are not distributed onto the GTS: the group recognized that most of the data of value for operational purposes were already available on the GTS.

Observations of waves and sea ice

6.12 The group noted with interest reports from the JCOMM Expert Teams on Wind Waves and Storm Surges and on Sea Ice (both formally part of the Services Programme Area), respectively concerning observations of waves and sea ice. It recognized that both these teams were well established and focussed, and that although the primary emphasis of their work in each case was on services, this work in practice cuts across all JCOMM Programme Areas, from Observations, through Data Management to Capacity Building. In this context, they were both directly involved in different ways in the coordination and/or standardization of their respective observations.

6.13 The group therefore agreed that, while it should remain abreast of activities relating to observations of waves and sea ice undertaken by these Expert Teams, it should not become directly involved unless specifically requested to do so. In this context, it noted and took action on the following aspects of wave observations, where the Expert Team on Waves and Surges was not currently active:

(i) *Wave observations by coastal radars*: It was agreed that this was an important topic, in particular in the context of services for ports and harbours and other coastal applications. It therefore requested the Secretariat to consider arranging for the preparation of a status report on such observations, as a first step in providing appropriate guidance to operational agencies; (**Action**: Secretariat)

(ii) *Wave and related data on the GTS*: The group agreed that the facilitation of the distribution of such data on the GTS (including issues relating to codes and formats) was more appropriate for the Data Management Coordination Group to consider; (**Action**: DMCG)

(iii) *Wave observation practices included in training workshops*: The Secretariat was requested to take action on this issue, within the context of future workshops on waves and surges; (**Action**: Secretariat)

(iv) *Enhancement of the shipboard report compilation and transmission software regarding wave observation practices:* This is an action for the Ship Observations Team; (**Action**: Chair of SOT and Secretariat)

(v) *Automated wave observations from ships*: The Secretariat was requested to identify, in coordination with the chairman of the SOT, an appropriate expert to prepare a technical report on this issue, for possible eventual further action through VOSClim. (**Action**: Secretariat, chair SOT, VOSClim Project Leader)

6.14 In addition, the group requested the ETWS to consider the possibility of designating a global network of in situ wave buoys, to provide the ground calibration segment for both satellites (altimeters) and wave models. (**Action**: Secretariat and ETWS)

Instrument evaluations

6.15 The group was informed that, following a request by JCOMM-I, the first session of the SOT had considered in detail the question of instrument evaluations and intercalibration. The SOT had recognized very clearly the importance of this issue. It agreed that it crosscut all the panels and that, while not necessarily solvable immediately, nevertheless should be urgently addressed. The SOT noted that there were at least three different pathways possible for undertaking such evaluations:

(i) Through the different panels and other platform-specific groups, as happened now on an ad hoc basis;
(ii) Through the establishment of a formal JCOMM instrument evaluation, intercomparison and testing programme;
(iii) Through existing CIMO (WMO Commission for Instruments and Methods of Observation) mechanisms, with JCOMM providing the required technical expertise.

6.16 To address all the issues relating to instrument evaluations for SOT, and prepare specific proposals for consideration by the Observations Coordination Group and SOT-II, the SOT had established an intersessional **Task Team on Instrument Testing and Intercalibration**, comprising experts from each of the three panels, to be convened by the SOT chairman.

6.17 The group noted this development with interest. It agreed generally that it was preferable to maintain such evaluations within the various specialized panels. In addition, it considered that the evaluations constituted a part of component data systems, and that the need for these to be properly resourced should therefore be clearly recognized in the development of these component systems. (**Action**: Observing system teams and panels; Management Committee)

7. Future work

7.1 Revised work plan

7.1.1 Based on discussions under preceding agenda items, the detailed work plan for the Observations Programme Area, including its component teams was revised. This revised work plan is given in *Annex X*.

7.1.2 The group requested that information regarding available JCOMM data and products, as well as on key JCOMM web-sites, be included in the JCOMM brochure, which the Management Committee was currently preparing. (**Action**: Secretariat to convey this to the Management Committee)

7.2 Implementation strategy

7.2.1 Based largely on discussions and consensus achieved under preceding agenda items, the group requested that an outline and preparation plan for an integrated Implementation Strategy for the Observations Programme Area be developed in time at least for submission to the second session of the Management Committee (Paris, February 2003). Such a draft outline would mainly encompass two parts: (i) present components of the OPA, as discussed under agenda items 4 and 5 above; and (ii) new directions for the OPA (e.g. western boundary currents, time series, ROSE, GOOS/COOP, hydrographic sections, etc.) (**Action**: OPA Coordinator with assistance of chairs of component teams and Secretariat).

7.3 Terms of Reference

7.3.1 The group reviewed both its terms of reference and also the expertise and breadth of its membership in view of these terms of reference. It agreed to maintain its TOR without change for the time being. The group further reviewed and agreed with the proposed revised TOR for the Ship Observations Team, developed at SOT-I (Goa, February-March 2002). These revised TOR are given in *Annex XI*. The group requested the chairman and Secretariat to convey this proposal to the next session of the JCOMM Management Committee, for approval on behalf of the Commission. (**Action**: Chairman and Secretariat.)

7.3.2 At the same time, the group considered that it would benefit greatly from representation at its meetings by both groups and programmes involving other types of observations (e.g. time series, repeat hydrography, western boundary currents) and also science design bodies. It therefore requested its chairman and the Secretariats to arrange for such representation in the future, as appropriate. (**Action**: Chairman and Secretariat) The group also considered that it was potentially valuable to get future input on different regional data requirements and applications, including from the regional GOOS alliances. (**Action**: Chairman and Secretariat)

7.4 User feedback for GTS data

7.4.1 Etienne Charpentier presented a proposal by the DBCP for relaying quality information from data users back to platform operators as a JCOMM integrated mechanism for data buoys and other platforms. The proposal was drafted based on the successful DBCP QC guidelines which had operated for many years. This system might be used as a model for quality information feedback from users for other platform types.

7.4.2. The proposed scheme recognizes that real-time data users such as ECMWF, NCEP, FNMOC, the Met Office(U.K.) and Météo-France are in an excellent position to provide information relating to observation data quality, but generally lack the capability to rapidly relay that information back to the platform operators. At the same time, JCOMMOPS is tasked (by DBCP, SOOP, and Argo) to maintain lists of operational platforms and platform operators and has the resources to collect such information, and to relay available quality information back to the platform operators.

7.4.3. The DBCP model could, however, be improved and rationalized to (i) make problem reporting consistent among the different types of platforms and relatively easy for the data centres, (ii) speed up and automate the relay of the information to the platform operators, (iii) eventually save human resources at JCOMMOPS, and shorten the delays for identified problems to be corrected (e.g. removing platform data from GTS, re-calibrating a sensor).

7.4.4. The meeting agreed that VOS data, which were already subject to user feedback procedures similar to those for buoy data, could be accommodated within this proposal with relatively little additional work on the part of the coordinator. It therefore requested that a feasibility study should be made of this aspect, despite the fact that the VOS were not yet a part of JCOMMOPS. If the study, to be assessed by the chairman of the OCG and the Secretariat, proved it to be realistic, the coordinator was requested to proceed with implementation. (**Action**: Coordinator, chairman and Secretariat)

7.4.5 On the other hand, the group did not consider it appropriate to implement the proposal for SOOP, Argo and ASAP for the time being, because of the specific requirements and characteristics of these systems.

7.4.6 Because of its implications with regard to data management aspect, the meeting asked the coordinator to work closely with the JCOMM Data Management Programme Area in further developing the system with regard to data buoys and the VOS. (**Action**: Coordinator and DMCG)

7.5 Issues and recommendations for the Management Committee and other Programme Areas

7.5.1 In addition to the proposed revised terms of reference for the Ship Observations Team, which it had reviewed under agenda item 7.3, the group addressed one further issue arising from SOT-I (Goa, February-March 2002).

Reporting original wind data without height correction

7.5.2 The group noted that, during a discussion of observational elements to be reported by ships, the Voluntary Observing Ship Panel of the SOT had recognized that original wind speed and direction were often reported, without height correction applied. At the same time, according to existing WMO technical guidance wind reduced to 10m should be, and thus often is, reported, e.g. with the TURBOWIN software. The Panel expressed concern that whether a particular vessel reports the original observation or reduced wind value cannot be detected in the current format. It recognized that the original purpose for reporting the reduced (10m) wind speed was no longer particularly relevant for operational meteorology. At the same time, it was agreed that it was much more valuable scientifically (e.g. for climate studies) if the original wind data were reported.

7.5.3 The panel had therefore requested that a recommendation to this effect should be submitted for consideration at JCOMM-II, through the Observations Coordination Group and the Management Committee. It noted that data input software packages automatically report the reduced wind, and thus a considerable transition period would be needed. Also information on whether the reported value is the original wind or the reduced value will be indispensable, especially during the transition period. The VOS Panel chair and the VOSClim leader were requested to develop a procedure for obtaining this information in the short term.

7.5.4 The group endorsed the proposal and requested the chairman and Secretariat to pass it to the Management Committee. After the approval of the Management Committee, a formal recommendation to be submitted to JCOMM-II should be drafted, for an eventual amendment to the WMO Technical Regulations.(**Action**: Chairman and Secretariat)

Other issues for the Management Committee

7.5.5 The group requested that the draft implementation strategy for the OPA should be brought to the attention of the Management Committee (**Action**: Chairman and Secretariat):

Issues for other PAs

7.5.7 The group suggested that the Capacity Building Coordination Group (CBCG) should develop a liaison with POGO regarding its fellowship programme, to enhance capacity to contribute to the overall observing system. (**Action**: CBCG, Secretariat)

8. Date and place of the next meeting

8.1 The group agreed that, in principle, its next formal meeting should be in the first half of 2004, with exact dates and place to be decided later by the chairman and Secretariat. (**Action**: Chairman, Secretariat) At the same time, it considered that advantage should be taken, where possible, of attendance of significant numbers of the group at other events, to convene special ad hoc sessions to address specific issues of immediate importance. As an example, the AGU/EGU session in Nice, April 2003, was suggested as a possibility.

9. Closure of the session

9.1 The first meeting of the JCOMM Observations Programme Area Coordination Group closed at 1245 hours on Saturday, 27 April 2002.

Annex I

LIst of Participants

AUSTRALIA

Mr Rick Bailey
Chairman, JCOMM Ship Observations Team
CSIRO/BMRC
Joint Australia Facility for Ocean Observing Systems
G.P.O. Box 1289K
MELBOURNE, Vic. 3001
Australia
Telephone: +61-3 9669 4170
Telefax: +61-3 9669 4660
E-mail: rick.bailey@marine.csiro.au

Mr Graeme Brough
Chairman, DBCP
Bureau of Meteorology
G.P.O. Box 1289 K
MELBOURNE, Vic. 3001
Australia
Telephone: +61-3 9669 4163
Telefax: +61-3 9669 4168
E-mail: g.brough@bom.gov.au

CANADA

Dr Savithri (Savi) Narayanan
Co-president, JCOMM
Marine Environmental Data Service
Dept. of Fisheries and Oceans
WO82, 12th floor
200 Kent Street
OTTAWA, Ontario
Canada K1A 0E6
Telephone: +1-613 990 0265
Telefax: +1-613 993 4658
E-mail: narayanans@dfo-mpo.gc.ca

CHINA

Professor Zhouwen Yu
National Centre for Marine Environment Forecast, SOA
8 Dahuisi Road, Haidian District
BEIJING 100081
China
Telephone: +86-10 6217 3625
Telefax: +86-10 6217 3620
E-mail: yuzw@nmefc.gov.cn
yuzw@sun.ihep.ac.cn

JAPAN

Dr Hiroshi Kawamura
JCOMM Satellite Expert
Center for Atmospheric and Oceanic Studies
Graduate School of Science
Tohoku University
SENDAI 980-8578
Japan
Telephone: +81-22 271 6745
Telefax: +81-22 217 6748
E-mail: kamu@ocean.caos.tohoku.ac.jp

USA

Dr Michael McPhaden
Chairman, Tropical Moored Buoy
Implementation Panel
NOAA/PMEL
Bldg. 3, Bin C15700
7600 Sandpoint Way N.E.
SEATTLE, WA 98115
USA
E-mail: mcphaden@pmel.noaa.gov

Dr Gary Mitchum
Dept. of Marine Science
College of Marine Science
140 7th Avenue S.
ST PETERSBURG, FL 33701
USA
Telephone: +1-727 553 3941
Telefax: +1-727 553 1189
E-mail: mitchum@moke.marine.usf.edu
(representing GLOSS)

Dr Dean Roemmich
Chairman, Argo Science Team
Scripps Institution of Oceanography
University of California San Diego
9500 Gilman Drive
Mail Code 0230
LA JOLLA, CA 92093
USA
Telephone: +1-858 534 2307
Telefax: +1-858 534 9820
E-mail: roem@kakapo.ucsd.edu

Dr W. Stanley Wilson
JCOMM Observations PA Coordinator
Chairman, JCOMM Observations
Coordination Group
NOAA, HCHB 5224
14th and Constitution Avenue, NW
WASHINGTON, DC 20230
USA
Telephone: +1-202 482 3385
Telefax: +1-202 482 5231
E-mail: stan.wilson@noaa.gov

OBSERVERS FOR ORGANIZATIONS AND PROGRAMMES

Mrs Muriel Cole
Programme Specialist
Office of Chief Scientist
NOAA
US Department of Commerce
14th St. & Constitution Avenue NW
WASHINGTON, DC 20230
USA
Telephone: +1-202 482 2049
Telefax: +1-202 482 5231
E-mail: Muriel.Cole@noaa.gov

Mr Steven K. Cook
Chairman, SOOPIP
Atlantic Oceanographic and Meteorological
Laboratories (R/AOML)
Office of Oceanic and Atmospheric Research
(NOAA)
8604 La Jolla Shores Drive
LA JOLLA, CA 92038
USA
Telephone: +1-858 546 7103
Telefax: +1-858 546 7185
E-mail: skcook@ucsd.edu

Dr D.E. Harrison
Pacific Marine Environmental Laboratory
NOAA/PMEL/OCRD
7600 Sand Point Way, NE
SEATTLE, WA 98115
USA
+1-206 526 6225
+1-206 526 6743 or 44
E-mail: harrison@pmel.noaa.gov

Mr Michael Johnson
NOAA Office of Global Programs
1100 Wayne Avenue, Suite 1210
SILVER SPRING, MD 20910
USA
Telephone: +1-301 427 2089 ext. 169
Telefax: +1-301 427 2073
E-mail: johnson@ogp.noaa.gov

Dr Shubha Sathyendranath
Executive Director, POGO
Mail Stop B240
Bedford Institute of Oceanography
DARTMOUTH, Nova Scotia B2Y 4A2
Canada
Telephone: +1-902 426 8044
Telefax: +1-902 426 9388
E-mail: shubha@is.dal.ca
Web: http://www.oceanpartners.org

Mr Gary Soneira
AOML
Office of Oceanic and Atmospheric Research
1335 East-West Highway Suite 101
SILVER SPRING, MD, 20901
USA
Tel: +1 301 713 2790 Ext 288
Fax: +1 301 713 4499
E-mail: Gary.Soneira@noaa.gov

Mr Bertrand Thompson
GOOS Consultant
502 South Hanover Street
BALTIMORE, MD 21201
USA
Telephone: +1-410 234 0780
+1-570 488 6797
(15 June-10 Sept)
E-mail: thompson@diu.udel.edu

Dr Stephen B. Weisberg
Executive Director
Southern California Coastal
Water Research Project Authority
7171 Fenwick Lane
WESTMINSTER, CA 92630
USA
Telephone: +1-714 372 9203
E-mail: stevew@SCCWRP.ORG

SECRETARIAT

Mr Etienne Charpentier
Technical Coordinator, DBCP and SOOP
JCOMMOPS
Parc Technologique du Canal
8-10 rue Hermes
F-31526 RAMONVILLE SAINT-AGNE
France
Telephone: +33-5 61 39 47 82
Telefax: +33-5 61 75 10 14
E-mail: charpentier@jcommops.org

Dr Peter E. Dexter
Oceans Affairs Division
World Weather Watch-Applications
Department
World Meteorological Organization
7 bis, Avenue de la Paix
Case postale No 2300
CH-1211 GENEVE 2
Switzerland
Telephone: +41-22 730 82 37
Telefax: +41-22 730 80 21
E-mail: dexter@www.wmo.ch

Mr Yves Tréglos
GOOS Project Office
UNESCO/Intergovernmental
Oceanographic Commission
1, rue Miollis
75732 PARIS Cédex 15
France
Telephone: +33-1 45 68 39 76
Telefax: +33-1 45 68 58 12/3
E-mail: y.treglos@unesco.org

Annex II

Agenda

1. Opening of the session

1.1 Opening
1.2 Adoption of the agenda
1.3 Working arrangements

2. Reports

2.1 Chairman and Secretariat
2.2 Component teams and rapporteurs

2.2.1 Ship Observations Team (SOT)
2.2.2 Data Buoy Cooperation Panel (DBCP)
2.2.3 Tropical Moored Buoy Implementation Panel (TIP)
2.2.4 Argo Science Team (AST)
2.2.5 Global Sea-Level Observing System (GLOSS) Group of Experts
2.2.6 JCOMM Satellite Rapporteur
2.2.7 JCOMM *in situ* Observing Platform Support Centre (JCOMMOPS)

3. Requirements and interactions

3.1 Operational meteorology and oceanography, Numerical Weather Prediction (NWP)
3.2 Climate, OceanObs99
3.3 Office of Global Programs (OGP)/NOAA
3.4 Partnership of Observations of the Global Ocean (POGO)
3.5 Non-physical ocean data

4. System overview and cross-cutting issues

5. Integrated performance metrics and mapping

6. Additional crosscutting issues

6.1 Vandalism of unmanned ocean platforms
6.2 Capacity building
6.3 Real-time data dissemination
6.4 Observations of waves and sea ice

7. Future work

7.1 Revised work plan
7.2 Implementation strategy
7.3 Terms of Reference
7.4 User feedback for GTS data
7.5 Issues and recommendations for the Management Committee and other JCOMM Programme Areas

8. Date and place of the next meeting

9. Closure of the session

Annex III

Report from the Chairman

For each of the Systems/Panels:

- What is the rationale for the system? How is the system justified? How/where is it documented?
- Has this rationale been reviewed by the OOPC? Other groups (eg, World Weather Watch)? Report(s) available?
- What is the desired coverage? Global?
- What is the status toward achieving the desired coverage?
- What are the major issues the system is facing?
- What does it cost? Who are the sponsoring funding agencies?
- Who are the major users of the resulting data?
- To what extent has the operational utility of the data been demonstrated?

Cross-cutting Issues:

- What is the experience with vandalism? Has any approach been successful in reducing it?
- How can we maximize getting data (eg, XBTs, drifters...) onto the GTS?
- Are there additional ways JCOMMOPS can contribute?
- Incorporation of future non-physical observations
- Funding is a shared issue affecting all
- Performance metrics—how do we measure progress?

Funding is a Shared Issue:

- SOOP: Have only been able to deploy 24,000 XBTs of the desired 35,000
- GLOSS: Only 2/3rds of the Core Network are operational
- TIP: Only two 2 TAO/TRITON-type moorings in the Indian Ocean
- Support for ‘Time Series’ observations
- Argo: Support in Japan and U.K. beyond an initial 5-year demonstration period
- Drifters: Desire to increase from 800 to 1200 drifters for improved SST
- Satellites: Long-term commitments for altimetry and scatterometry

Desired Overall System:

- What are the requirements for observed parameters and derived fields (eg, fluxes)?
- How do component systems (or platforms) contribute?
- What does the overall system look like, expressed in terms of a complementary mix of component systems (including satellites)?

Performance Metrics:

- How do we track implementation—what is needed versus what is in place?

Annex IV

Summary Report on the Results of JCOMM-I

Introduction

1. The Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) was formally established in 1999 by Thirteenth Congress and the Twentieth Session of the IOC Assembly, through a merger of the Commission for Marine Meteorology (CMM) and the Joint IOC/WMO Committee for IGOSS. JCOMM is the reporting and coordinating mechanism for all operational marine activities in both WMO and IOC. As such, it is charged with the international coordination, regulation and management of an integrated, operational, oceanographic observing, data management and services system which will eventually become the ocean equivalent of the World Weather Watch.

2. The first session of JCOMM took place in Akureyri, Iceland, from 19 to 29 June 2001. Substantial support for the meeting, as well as warm and generous hospitality, was provided by the Icelandic Meteorological Office and by the City and University of Akureyri. At the opening ceremony, participants were welcomed by Ms Siv Fridleifsdottir, Minister for the Environment; Mr Magnus Jonsson, Permanent Representative of Iceland with WMO; Mr Kristjan Thor Juliusson, Mayor of Akureyri; Professor G.O.P. Obasi, Secretary-General of WMO; and Dr Patricio Bernal, Executive Secretary of IOC. The Commission was also honoured by a visit during the second week of the session by Dr Olafur Ragnar Grimsson, President of Iceland, and by Dr John Zillman, President of WMO.

3. While the membership of JCOMM is still growing, at the time of the session the Commission had approximately 250 members from 122 Members of WMO and Member States of IOC. The session was attended by 113 participants from 42 Members/Member States and 11 international organizations. It was particularly pleasing to note that almost all the national delegations included approximately equal numbers of meteorologists and oceanographers. This was an indication of the importance which both communities placed on JCOMM, and it also ensured a good balance in the debates during the session and in the priority issues to be addressed by the Commission. The DBCP was represented at the session by David Meldrum, vice-chairman, and Etienne Charpentier, technical coordinator.

4. In their report to the session, the interim co-presidents, Mr Johannes Guddal and Professor Dieter Kohnke, firstly recalled the dramatic progress which had been made since CMM-XII (Havana, March 1997) in developing the JCOMM concept, in its acceptance by the governing bodies of WMO and IOC, and in the transition to the new institutional and working arrangements. They then briefly outlined the substantive achievements during the past intersessional period, under CMM, IGOSS and also all the other groups now reporting to JCOMM. These included further consolidation in the marine broadcasting system for the GMDSS, the Marine Pollution Emergency Response Support System (MPERSS) and the Global Digital Sea Ice Data Bank (GDSIDB); implementation of the VOSClim Project and of an operational Ship-of-Opportunity Programme; substantial enhancements to global data buoy deployments and the commencement of the Argo Project of sub-surface profiling floats; the implementation of the electronic JCOMM Products Bulletin; and major capacity building activities. The interim co-presidents continued by outlining a vision for the future of JCOMM, as well as major issues to be addressed during the coming intersessional period. These included in particular the phased implementation of a fully integrated, operational ocean observing, data management and services system; implementation of a JCOMM in situ Observing Platform Support Centre (JCOMMOPS); close collaboration with GOOS and GCOS, in particular in ocean observations and data management for climate; and implementation of the new JCOMM Capacity Building Strategy.

Scientific input and requirements

5. There was full agreement at the session that a major priority for the coming intersessional period would be the implementation and maintenance of an operational ocean observing system to

provide the data required to support global climate studies. Detailed requirements for these data have been developed and will be maintained by the Ocean Observations Panel for Climate of GOOS, GCOS and the WCRP, which thus becomes one of the primary scientific advisory bodies for JCOMM. In reviewing the report of the OOPC to the session, the Commission recognized a number of priority requirements, including the implementation and long-term maintenance of Argo and its integration with the SOOP; operational implementation of VOSClim; long-term resources for system maintenance; and integrated data management.

Marine meteorological and oceanographic services

6. The Commission noted with satisfaction that the WMO marine broadcast system for the GMDSS of IMO had been fully implemented prior to the final implementation date for the GMDSS of 1 February 1999, and congratulated all concerned for this outstanding work. It adopted a number of small amendments to the regulations covering the GMDSS marine broadcast system as given in the Manual on Marine Meteorological Services (WMO-No. 558), which included two new Metareas (17 and 18) to allow for the extension of SafetyNET services in Arctic waters. At the same time, the Commission recognized the ongoing need for terrestrial maritime safety broadcasts to some coastal waters and for shipping not subject to SOLAS, and therefore agreed to maintain the existing terrestrial broadcast component of the Manual pending a major revision by the Expert Team on Maritime Safety Services. The Commission further recognized the importance to mariners of meteorological information in graphical form, and therefore urged the early completion of the project for the delivery of such graphical information through Inmarsat C, as part of SafetyNET. The Commission reviewed the status of the project for the harmonization of meteorological services delivered by NAVTEX in the Baltic Sea region, urged rapid formal acceptance of the guidelines developed under the project, and commended the rapporteur (Dr Michal Ziemianski, Poland) and his co-workers for their efforts in preparing and testing these guidelines.

7. The Commission recognized that the wave programme had continued to provide valuable support to many Members/Member States in their provision of wave related services to users. It noted a detailed revised programme of action for the coming four years, and agreed that the programme should be extended to cover also the analysis, modelling and forecast of storm surges. The Commission also recognized the considerable importance of on-going work on sea ice and polar region issues, in particular to maritime safety and global climate studies. It noted with appreciation the substantial on-going development of the Global Digital Sea Ice Data Bank, which it agreed was an important resource supporting the WCP, as well as the work undertaken on ice codes, formats and nomenclature. The Commission fully supported enhanced involvement with external sea ice groups such as the Baltic Sea Ice Meeting and the International Ice Charting Working Group.

8. The Commission strongly supported the full implementation of the Marine Pollution Emergency Response Support System, as a means of providing coordinated and timely meteorological and oceanographic data and services to support operations in response to major pollution emergencies originating outside territorial waters. It expressed appreciation for the seminar and workshop on MPERSS held in Townsville, Australia, in 1998, and agreed that another such event in support of MPERSS implementation should take place in 2002 or 2003. The Commission recognized the considerable value of the JCOMM Electronic Products Bulletin, as a means of making easily available to Members/Member States both data sets and tailored oceanic products on an operational basis. It agreed on the importance of securing the resources needed to ensure its long-term maintenance, and further supported the concept of a specialized workshop on "JCOMM Products in Support of Operational Oceanography and Marine Meteorology", to provide a catalyst for further development of the Bulletin. Finally, the Commission acknowledged the continuing importance, to both service providers and users, of the regular monitoring of user responses to marine meteorological services. It reviewed the results of the most recent such survey and urged their wide distribution. It agreed that the next survey of this type should take place in 2004.

Observing systems

9. Existing and future operational ocean observing networks involve a complementary mix of in situ and remote sensing technologies and platforms. These include ship-based systems (the traditional VOS, the XBT ship-of-opportunity programme, ASAP and future non-physical measurements), autonomous unmanned devices (drifting and moored buoys, floats, other sub-surface vehicles), tide gauges and coastal stations, satellites, aircraft and ground-based radars. The increasing requirement of all users for the delivery of fully integrated data and product streams is, in turn, increasing pressure for a more integrated approach to the observing systems themselves. As a first step towards such enhanced integration, the Commission agreed to establish a Ship Observations Team, grouping the existing ship-based observing panels (VOS, SOOP and ASAP), and creating a mechanism to deal more easily with new observation requirements and technologies. Further with regard to ship-based observations, the Commission was particularly appreciative of the expansion of the ASAP network through the Eumetnet ASAP Project (E-ASAP) and the Worldwide Recurring ASAP Project (WRAP); the implementation of the VOSClim Project, to establish a high-quality reference subset of VOS meteorological data; and the restructuring of the SOOP XBT network in response to the upper ocean thermal review recommendations.

10. The Commission recognized that both drifting and moored ocean data buoys now constitute a major component of the integrated ocean observing system, and that the DBCP had been instrumental both in enhancing the coordination of national and regional buoy programmes, and also in improving the quantity and quality of buoy data available on the GTS. At the same time, the Commission noted the substantial on-going problem caused through the vandalism of data buoys, and adopted a recommendation designed to address this problem. The Commission further recognized that the Argo project represents a significant development in large-scale oceanography, and agreed that it should eventually become a part of the overall operational ocean observing system coordinated through JCOMM.

11. Oceanographic satellites constitute an essential component of the present and future operational ocean observing system. The Commission recognized that it is of fundamental importance to identify the observational requirements of JCOMM in relation to continuing satellite missions and to establish a dialogue on the complementary value of in situ data and products to satellite agencies. In this context, an immediate challenge is to work with operators, through various mechanisms, to develop continuity and sustained operation, as discussed in the IGOS Oceans Theme document. To this end, the Commission agreed that several different paths to the operators could and should be used, provided that the message conveyed is consistent and coherent. These include: with GOOS through the IGOS Partners and the Oceans Theme; through the CBS processes, such as the Rolling Requirements Review; CGMS; and the Consultative Meetings on High Level Policy on Satellite Matters.

12. The Commission strongly supported the proposal to establish a JCOMM in situ Observing Platform Support Centre (JCOMMOPS), based initially on the existing DBCP/SOOP and Argo coordination mechanisms. It recognized that the centre is already operational, and a review is to be undertaken to assess the benefits and efficiency that might be achieved by extending the terms of reference of JCOMMOPS to include also support for VOS and ASAP.

Data management

13. The Commission undertook a thorough review of the status of existing marine data management activities falling within its area of responsibility, including in particular those for VOS data (the Marine Climatological Summaries Scheme, MCSS), for sub-surface temperature and salinity (the Global Temperature and Salinity Profile Programme, GTSPP), and for buoy and float data (managed through the DBCP and Argo, respectively). The Commission adopted the comprehensive metadata format for ocean data acquisition systems, developed by the DBCP and the former CMM Subgroup on Marine Climatology.

14. At a general level, the Commission agreed that a fundamental principle for its data management was to integrate meteorological and ocean measurements and to provide multi-parameter products and services in response to user needs. It therefore charged its Data Management Coordination Group, together with the Expert Team on Data Management Practices, with reviewing and assessing overall JCOMM requirements for end-to-end data management, and with developing a strategy for the Commission in this regard. The Commission also recognized that there was a considerable amount of related work, in particular using Internet and other new technologies, being undertaken or planned elsewhere. This included the future WMO information systems project within CBS, the development of standard metadata languages such as XML, and a proposed ocean and marine meteorology data and information technology project. It agreed that JCOMM should follow all this work very closely, and be involved where appropriate, and requested the Data Management Coordination Group to undertake this task.

Capacity building

15. The Commission noted with appreciation the large number of specialized training workshops which had been conducted during the intersessional period, on topics such as remote sensing, marine pollution, wave and surge forecasting, sea level measurements and the work of PMOs, as well as the fellowships for long-term marine training awarded by WMO. It urged that these activities should be continued in support of JCOMM, and at the same time requested its new Task Team on Resources to investigate potential new sources of funding for training. The Commission reviewed and adopted an overall JCOMM Capacity Building Strategy document, which it agreed provided a blueprint and general framework for the conduct of all future JCOMM capacity building activities.

External relations

16. While JCOMM needs to interact in various ways with most of the other major programmes and bodies of WMO and IOC, it will continue to have particularly close relations and interactions with GOOS, GCOS, CBS and IODE. One aspect of such interactions which engendered considerable debate concerned the developing requirements under GOOS for the international operational collection, exchange and management of non-physical ocean data (ocean chemistry and biology). It was recognized that JCOMM is most probably the appropriate mechanism to undertake this work, but at the same time the Commission presently has no expertise or capabilities in these disciplines. The Management Committee was therefore requested to interact with GOOS on this subject, with a view to eventually developing some formal proposals for the Commission.

17. Outside WMO and IOC, JCOMM will continue to work closely with international organizations and bodies such as IMO, IHO, UNEP, ICSU/SCOR, etc. in a number of areas of common interest and concern. The Commission also supported the continuing involvement of WMO and IOC in various inter-agency coordination activities relating to the oceans, including in particular preparations for and participation in the World Conference on Sustainable Development, Johannesburg, September 2002. It noted with satisfaction that both WMO and IOC had actively supported and contributed to the development of the UN Atlas of the Oceans project.

Scientific lectures

18. One half-day of the session was devoted to a set of scientific lectures on the general theme of “operational oceanography”. The texts of these will be published as a JCOMM Technical Report, and similar scientific lectures are planned for JCOMM-II.

JCOMM sub-structure

19. The Commission decided that its work and sub-structure would be organized within four Programme Areas, each managed by a Coordinator and small Coordination Group – Services, Observations, Data Management and Capacity Building. Within each Programme Area, specific

activities will be undertaken by a number of Expert Teams, Task Teams and Panels. Overall guidance and oversight for the work of the Commission will be provided by a Management Committee, chaired by the two co-presidents of JCOMM, and including the four Programme Area Coordinators and a small number of other selected experts. The nine members of the Committee include four meteorologists, four oceanographers and one polar region expert. The DBCP, with its Action Groups, constitutes an essential component of the Observations Programme Area, for which the coordinator is Dr Stan Wilson (USA). The DBCP chairman is an ex-officio member of the Observations Coordination Group, but the panel itself will continue, for the time being at least, to maintain its statutory and functional autonomy from JCOMM.

Elections

20. The Commission elected Mr Johannes Guddal (Norway) as its co-president for meteorology and Dr Savi Narayanan (Canada) as its co-president for oceanography.

Next session

21. The Commission was pleased to accept the offer from Canada to host its second session in the year 2005.

Annex V

Tropical Moored Buoy Implementation Panel

Michael McPhaden, chairman of the Tropical Moored Buoy Implementation Panel, reviewed the status and plans for tropical moored buoy programmes 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. Data from this array underpins recent forecasts issued by NCEP and the 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, as well as on-going and planned South American buoy programmes sponsored by Peru, Ecuador, and Chile.

In the Atlantic, the French, Brazilian, US PIRATA array is being continued for a five-year "consolidation phase" (2001-2005). Representatives from agencies in the three sponsoring 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 provide long term support for PIRATA and other elements of GOOS. Adequacy of ship time is an issue in PIRATA, since less frequent buoy servicing compared to much of the Pacific (once vs. twice per year) adversely affects data return.

In the Indian Ocean, efforts are underway to establish an initial moored buoy network for climate studies. These efforts include JAMSTEC TRITON buoys (deployed at 1.5S, 90E and 5S, 95E in October 2001) and 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 by South Africa in collaboration with neighboring countries, by US academic and government labs, and by 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. There are also reports of vandalism to Indian Ocean buoys. Outreach and engineering efforts to address this problem continue, but they are of limited success. Adequacy of funding for sustained observations is also a concern. In particular, fixed funding levels that are not adjusted for inflation and other increases in operating costs can result in budgets that do not keep pace with programme requirements.

"Requirement"	AffIdent	Use	KeyUni	HorRes	UHorRe	bsCyc	bs	"Time"	Tim	"Acc"	UAcc	UP_KEY	HR Min	OC Min	DA Mi	AC Min
Aerosol (total column) size	GOOS_0012	(open ocean)	126	4	km	24	h	3	h	0.1	µm	180	50	48	7	1
Aerosol (total column) size	GOOS_0013	(coastal water)	126	1	km	24	h	3	h	0.1	µm	181	10	48	7	1
Air pressure over sea surface	GOOS_0010	(open ocean)	137	50	km	24	h	3	h	10	hPa	180	100	48	7	15
Dominant wave direction	GOOS_0023	GOOS Surface	147	10	km	1	h	2	h	10	es	177	30	6	4	20
Dominant wave period	GOOS_0023A	GOOS Surface	146	10	km	1	h	2	h	0.5	s	177	30	6	4	1
Geoid	GOOS_0025	JGOOS-III	184	250	km	240	o	12	y	2	cm	178	500	360	24	5
Ocean chlorophyll	IDCCG_0009	Open ocean	149	0.5	km	1	d	0.04	d	10	(Max)	188	10	10	14	30
Ocean chlorophyll	GOOS_0014	large scale	149	25	km	1	d	1	d	0.1	(Max)	175	100	3	3	0.5
Ocean chlorophyll	GOOS_0001	(open ocean)	149	10	km	1	d	3	d	0.1	(Max)	180	50	3	7	0.5
Ocean chlorophyll	GOOS_0002	(coastal water)	149	1	km	1	d	3	d	5	(Max)	181	5	3	7	20
Ocean chlorophyll	IDCCG_0008	Coastal ocean	149	0.05	km	0.0416	d	0.04	d	10	(Max)	187	0.5	2	14	30
Ocean dynamic topography	GOOS_0021	mesoscale	194	25	km	7	d	2	d	2	cm	183	100	30	15	10
Ocean dynamic topography	GOOS_0020	large scale	194	100	km	10	d	10	d	2	cm	175	300	30	30	5
Ocean salinity	GOOS_0019	large scale	152	200	km	10	d	10	d	0.1	psu	175	500	30	30	1
concentration	IDCCG_0007	Coastal ocean	150	0.05	km	0.0416	d	0.04	d	10	(Max)	187	0.5	2	2	20
Ocean yellow substance absorbance	IDCCG_0006	Coastal ocean	151	0.05	km	0.0416	d	0.04	d	10	(Max)	187	0.5	2	2	20
Ocean yellow substance absorbance	GOOS_0003	(open ocean)	151	1	km	1	d	3	d	5	(Max)	180	5	2	7	20
Outgoing spectral radiance at TOA	IDCCG_0001	Coastal ocean	200	0.05	km	0.0416	d	1	h	1	(Max)	187	0.5	2	336	2
Outgoing spectral radiance at TOA	IDCCG_0002	Open ocean	200	0.5	km	1	d	1	h	1	(Max)	188	10	10	336	2
Ozone profile - Total column	GOOS_0009	(open ocean)	38	50	km	24	h	3	h	10	DU	180	200	48	7	20
Photosynthetically Active Radiation (PAR)	GOOS_0005	(coastal water)	174	1	km	0.04	d	3	d	5	(Max)	181	5	1	7	20
Photosynthetically Active Radiation (PAR)	IDCCG_0005		174	0.05	km	0.0416	d	0.04	d	3	(Max)	186	0.5	1	2	10
Photosynthetically Active Radiation (PAR)	GOOS_0004	(open ocean)	174	10	km	0.04	d	3	d	5	(Max)	180	50	1	7	20
Sea surface bulk temperature	GOOS_0016	large scale	144	10	km	6	h	6	h	0.1	K	175	300	720	720	1
Sea surface bulk temperature	GOOS_0007	(coastal water)	144	1	km	24	h	3	h	0.1	K	181	5	48	7	0.5
Sea surface bulk temperature	GOOS_0006	(open ocean)	144	10	km	24	h	3	h	0.1	K	180	50	48	7	0.5
Sea surface bulk temperature	GOOS_0022	GOOS Surface	144	1	km	6	h	2	h	0.1	K	177	10	12	4	2
Sea-ice cover	GOOS_0015	large scale	156	10	km	1	d	0.13	d	2	(Max)	175	100	6	1	10
Sea-ice thickness	GOOS_0024	GOOS Surface	193	25	km	1	d	1	d	50	cm	177	100	6	6	100
Specific humidity profile - Total column	GOOS_0008	(open ocean)	17		km	24	h	3	h		kg/m2	180			7	
Water-leaving spectral radiance	IDCCG_0004	Open ocean	201	0.5	km	24	h	1	h	1	(Max)	188	10	240	336	2
Water-leaving spectral radiance	IDCCG_0003	Coastal ocean	201	0.05	km	1	h	1	h	1	(Max)	187	0.5	48	336	2
Wind speed over sea surface (horizontal)	GOOS_0018	large scale	141	25	km	24	h	24	h	1	m/s	175	100	168	168	2
Wind vector over sea surface (horizontal)	GOOS_0011	(open ocean)	143	4	km	24	h	3	h	2	m/s	180	50	48	7	5
Wind vector over sea surface (horizontal)	GOOS_0017	large scale	143	25	km	24	h	24	h	1	m/s	175	100	168	168	2

"Requirement"	AffIdent	Use	KeyUni	"HorRes	UHorRe	ertRe	VerRe	bsCyc	ObsC	"Time"	UTime	"Acc"	UAcc	P_KE	HR Min	R M	OC Min	DA Mi	AC Min
Aerosol profile - Total column	WMO_UA_017H	Nowcasting	33	5	km			0.25	h	0.25	h	10	%	93	50		12	2	20
Air temperature (at surface)	WMO_Sfc_008G	Nowcasting	138	5	km			0.25	h	0.25	h	0.5	K	93	20		1	0.5	1
Atmospheric stability index	WMO_UA_N004	Nowcasting	119	5	km			0.08	h	0.25	h		K	93	50		0.5	1	
troposphere (HT)	WMO_UA_003J	Nowcasting	2	5	km	1	km	0.25	h	0.08	h	1	K	93	200	3	1	0.5	2
troposphere (LT)	WMO_UA_003I	Nowcasting	1	5	km	0.5	km	0.25	h	0.08	h	0.5	K	93	200	1	1	0.5	2
Cloud cover	WMO_UA_013	Nowcasting	111	1	km			0.0083	h	0.02	h	5	(Max)	93	20		1	0.5	20
Cloud imagery	WMO_S_218C	Nowcasting	109	1	km			0.05	h	0.25	h			93	5		0.5	1	
Cloud top height	WMO_UA_009C	Nowcasting	113	1	km			0.01	h	0.02	h	0.1	km	93	10		0.5	0.5	1
Cloud top temperature	WMO_UA_011B	Nowcasting	114	1	km			0.01	h	0.02	h	0.5	K	93	10		0.5	0.5	2
Cloud type	WMO_UA_013B	Nowcasting	110	1	km			0.01	h	0.02	h	10	classes	93	10		0.5	0.5	5
Fire area	WMO_S_059	Nowcasting	177	5	km			0.25	d	1	d	5	(Max)	93	250		12	4	20
Fire temperature	WMO_S_059B	Nowcasting	178	5	km			0.25	d	1	d	500	K	93	250		12	4	1000
Boundary Layer	WMO_UA_N005	Nowcasting	122	5	km			0.25	h	0.08	h	50	m	93	50		1	0.5	500
Height of tropopause	WMO_UA_N006	Nowcasting	120	10	km			0.5	h	0.5	h	0.1	km	93	200		6	2	1
Land surface temperature	WMO_Sfc_008	Nowcasting	170	1	km			0.25	h	0.08	h	0.5	K	93	50		1	0.5	3
(NDVI)	WMO_S_254B	Nowcasting	172	5	km			1	d	1	d	5	(Max)	93	10		12	5	10
Ocean surface currents (vector)	WMO_S_165	Nowcasting	153	10	km			0.25	d	0.25	d	0.5	cm/s	93	50		6	4	1
Precipitation rate (liquid) at the surface	WMO_S_118B	Nowcasting	116	5	km			0.08	h	0.08	h	0.1	mm/h	93	50		1	0.5	1
Precipitation rate (solid) at the surface	WMO_Sfc_N045A	Nowcasting	117	5	km			0.25	h	0.5	h	0.1	mm/h	93	50		1	0.5	1
Sea surface bulk temperature	WMO_Sfc_006A	Nowcasting	144	5	km			1	h	1	h	0.5	K	93	50		6	2	2
Sea-ice cover	WMO_Sfc_019B	Nowcasting	156	5	km			1	d	1	d	10	(Max)	93	50		24	6	20
Snow cover	WMO_Sfc_023B	Nowcasting	163	5	km			1	h	1	h	10	(Max)	93	50		144	6	20
Soil moisture	WMO_Sfc_012D	Nowcasting	171	5	km			0.5	d	0.25	d	10	g/kg	93	50		2	1	50
troposphere (HT)	WMO_UA_006G	Nowcasting	14	5	km	1	km	0.25	h	0.08	h	5	%	93	200	3	1	0.5	20
troposphere (LT)	WMO_UA_006F	Nowcasting	13	5	km	0.5	km	0.25	h	0.08	h	5	%	93	200	1	1	0.5	20
Specific humidity profile - Total column	WMO_Sfc_N044	Nowcasting	17	5	km			0.25	h	0.08	h	1	kg/m2	93	50		1	0.5	5
Temperature of tropopause	WMO_UA_N006A	Nowcasting	121	10	km			0.5	h	0.5	h	0.5	K	93	200		6	2	2
Higher troposphere (HT)	WMO_UA_001J	Nowcasting	6	5	km	0.5	km	0.25	h	0.08	h	1	m/s	93	200	1	4	0.5	8
Lower stratosphere (LS)	WMO_UA_001P	Nowcasting	7	5	km	0.5	km	0.25	h	0.25	h	1	m/s	93	200	1	6	2	5
Lower troposphere (LT)	WMO_UA_001I	Nowcasting	5	5	km	0.5	km	0.25	h	0.25	h	1	m/s	93	200	1	6	2	5
troposphere (LT)	WMO_UA_N020B	Nowcasting	9	5	km	0.5	km	0.25	h	0.08	h	1	cm/s	93	200	2	1	0.5	5
Wind speed over land surface (horizontal)	WMO_Sfc_N007C	Nowcasting	140	5	km			0.25	h	0.25	h	1	m/s	93	50		3	1	5
Wind speed over sea surface (horizontal)	WMO_Sfc_N007B	Nowcasting	141	5	km			0.25	h	0.25	h	1	m/s	93	50		3	1	5
Wind vector over land surface (horizontal)	WMO_Sfc_N007A	Nowcasting	142	5	km			0.25	h	0.25	h	1	m/s	93	50		3	1	5
Wind vector over sea surface (horizontal)	WMO_Sfc_N007	Nowcasting	143	5	km			0.25	h	0.25	h	1	m/s	93	50		3	1	5

"Requirement"	AffIdent	Use	KeyUni	HorRe	UHorRe	ertRe	VerR	sCy	ObsC	Time	UTime	"Acc"	UAcc	P_KE	HRMin	VRMi	OCMi	DAMi	CMi
Aerosol profile - Lower troposphere (LT)	WMO_UA_017	NWP	29	50	km	0.1	km	1	h	1	h	10	%	91	500	1	168	168	20
Aerosol profile - Total column	WMO_UA_017F	NWP	33	50	km			1	h	1	h	10	%	91	500		168	168	20
Air pressure over sea surface	WMO_Sfc_004B	NWP	137	50	km			1	h	1	h	0.5	hPa	91	250		12	4	2
Air specific humidity (at surface)	WMO_Sfc_N011	NWP	139	50	km			1	h	1	h	5	%	91	250		12	4	15
Air temperature (at surface)	WMO_Sfc_008E	NWP	138	50	km			1	h	1	h	0.5	K	91	250		12	4	2
troposphere (HT)	WMO_UA_003A	NWP	2	50	km	1	km	1	h	1	h	0.5	K	91	500	3	12	4	3
troposphere (LT)	WMO_UA_003	NWP	1	50	km	0.3	km	1	h	1	h	0.5	K	91	500	3	12	4	3
Cloud base height	WMO_UA_N001	NWP	115	50	km			1	h	1	h	0.5	km	91	250		12	4	1
Cloud cover	WMO_UA_N023	NWP	111	50	km			1	h	1	h	5	(Max)	91	250		12	4	20
Cloud top height	WMO_UA_009	NWP	113	50	km			1	h	1	h	0.5	km	91	250		12	4	1
troposphere (HT)	WMO_UA_N013	NWP	19	50	km	1	km	1	h	1	h	5	%	91	250	10	12	4	20
troposphere (LT)	WMO_UA_N012	NWP	18	50	km	0.3	km	1	h	1	h	5	%	91	250	5	12	4	20
troposphere (HT)	WMO_UA_N013B	NWP	22	50	km	1	km	1	h	1	h	5	%	91	250	10	12	4	20
troposphere (LT)	WMO_UA_N012A	NWP	21	50	km	0.3	km	1	h	1	h	5	%	91	250	5	12	4	20
Dominant wave direction	WMO_Sfc_018C	NWP	147	50	km			1	h	1	h	10	es	91	250		12	4	20
Dominant wave period	WMO_Sfc_018	NWP	146	50	km			1	h	1	h	0.5	s	91	250		12	4	1
Long-wave Earth surface emissivity	WMO_Sfc_N020	NWP	135	15	km			24	h	24	h	1	(Max)	91	250		720	720	5
(NDVI)	WMO_S_254	NWP	172	50	km			7	d	1	d	1	(Max)	91	100		30	7	5
Outgoing long-wave radiation at TOA	WMO_UA_016F	NWP	125	50	km			1	h	240	h	5	W/m2	91	250		1	720	10
Outgoing short-wave radiation at TOA	WMO_UA_016	NWP	124	50	km			1	h	240	h	5	W/m2	91	250		6	360	10
Precipitation index (daily cumulative)	WMO_Sfc_017	NWP	118	50	km			1	h	24	h	0.5	mm/d	91	250		12	720	5
Precipitation rate (liquid) at the surface	WMO_UA_N022A	NWP	116	50	km			1	h	1	h	0.1	mm/h	91	100		12	4	1
Precipitation rate (solid) at the surface	WMO_UA_N022	NWP	117	50	km			1	h	1	h	0.1	mm/h	91	100		12	4	1
Sea surface bulk temperature	WMO_Sfc_006C	NWP	144	50	km			3	h	3	h	0.5	K	91	250		360	180	2
Sea-ice cover	WMO_Sfc_019	NWP	156	15	km			1	d	1	d	5	(Max)	91	250		15	7	50
Sea-ice surface temperature	WMO_Sfc_N014	NWP	158	15	km			1	h	1	h	0.5	K	91	200		12	4	4
Sea-ice thickness	WMO_Sfc_021	NWP	193	15	km			1	d	1	d	50	cm	91	250		7	7	100
Significant wave height	WMO_Sfc_N059B	NWP	145	100	km			1	h	1	h	0.5	m	91	250		12	4	1
Higher troposphere (HT)	WMO_UA_001A	NWP	6	50	km	1	km	1	h	1	h	1	m/s	91	500	10	12	4	8
Lower troposphere (LT)	WMO_UA_001	NWP	5	50	km	0.4	km	1	h	1	h	1	m/s	91	500	5	12	4	5
troposphere (HT)	WMO_UA_N020	NWP	10	50	km	0.5	km	1	h	1	h	1	cm/s	91	500	10	12	4	5
troposphere (LT)	WMO_UA_N019	NWP	9	50	km	0.5	km	1	h	1	h	1	cm/s	91	500	5	12	4	5
Wind speed over land surface (horizontal)	WMO_Sfc_010M	NWP	140	50	km			1	h	1	h	0.5	m/s	91	250		12	4	3
Wind speed over sea surface (horizontal)	WMO_Sfc_010I	NWP	141	50	km			1	h	1	h	0.5	m/s	91	250		12	4	3
Wind vector over land surface (horizontal)	WMO_Sfc_010E	NWP	142	50	km			1	h	1	h	0.5	m/s	91	250		12	4	5
Wind vector over sea surface (horizontal)	WMO_Sfc_010A	NWP	143	50	km			1	h	1	h	0.5	m/s	91	250		12	4	5

Annex VII

OOPC and OCG

Annex VII in separate file pp. 34-41

Annex VIII

Building a Sustained Ocean Observing System for Climate

Annex VIII in separate files pp. 42-57

Annex IX

Potential for Incorporating Non-physical Measurements in JCOMM

Stephen B. Weisberg

Southern California Coastal
Water Research Project
(www.sccwrp.org)

BACKGROUND

- **JCOMM-I requested consideration of non-physical variables**

- **GOOS Coastal Ocean Observations panel (COOP) prepared a document identifying possible non-physical measurements**

- **COOP authors are not available today**

  -- I was asked to substitute

SEVEN THEMES

- **Detecting and forecasting oceanic components of climate variability**
- **Facilitating safe and efficient marine operations**
- **Ensuring national security**
- **Managing resources for sustainable use**
- **Preserving and restoring healthy marine ecosystems**
- **Mitigating natural hazards**
- **Ensuring public health**

CHEMICAL

- **Physio-chemical**

  -- Dissolved oxygen
  -- Suspended solids
  -- Light attenuation

- **Nutrients**

  -- Ammonia
  -- Nitrate
  -- Phosphorous
  -- Silica

- **Contaminants**

  -- Metals
  -- PAH

- **Air-sea gas flux**

BIOLOGICAL

- **Chlorophyll**

  -- Abundance
  -- Speciation

- **Pathogens**

- **Fish**

  -- Sonic based

- **Marine mammals**

  -- Satellite imagery

JCOMM Observations Programme Area
Draft Work Plan 2001-2005 for the Observations Coordination Group
Revision 5, 8 May 2002

General Terms of Reference

The Observations Coordination Group shall be responsible for matters relating to further development of the observing networks:

- ♦ Under the guidance of the relevant scientific and operational programmes of IOC and WMO, development, maintenance, coordination and guidance of the operation of the global marine meteorological and oceanographic observing systems and supporting communication facilities of these organizations to meet the needs of the IOC and WMO Programmes—in particular of the Global Ocean Observing System (GOOS), the Global Climate Observing System (GCOS) and the World Weather Watch (WWW):
- ♦ Evaluation on a continuing basis of the efficiency of the overall observing system and suggesting and coordinating changes designed to improve it.

Specific Terms

(a) Review short- and long-term planning for those elements of the JCOMM work programme related to observations—ie, the Observations Programme Area (OPA)—and advise on their implementation;
(b) Assess the resources required for the implementation of those observational elements, as well as approaches to identifying and mobilizing the requisite resources;
(c) Coordinate and integrate the observational elements of JCOMM, as implemented through the various subgroups, both within the OPA and among companion Programme Areas;
(d) Review the internal structure and working methods of the Observations Coordination Group (OCG) within JCOMM, including its relationship to other bodies, both internal and external to JCOMM, WMO, and IOC, and develop proposals for modification as appropriate;
(e) Assess the implementation of activities and projects related to the OPA for action by the JCOMM Management Committee, companion Coordination Groups, and external bodies as appropriate, including in particular the GOOS/GCOS Implementation Action Plan;
(f) Contribute as required to the planning processes of JCOMM, WMO, and IOC.

Priority Issues for the Observations Programme Area

- Funding to implement the required components of the observing system:
  - -- SOT - Enhance HRX/FRX lines (requires 35,000 vice 24,000 XBTs);
    - Implement VOSClim with 200 ships;
    - Add additional Southern Hemisphere ASAP units.
  - -- DBCP - 50% increase in SST buoys, all buoys with barometers;
    - Enhance ice buoy deployments in accordance with implementation plan.
  - -- TIP - Extend the tropical buoy array into the Indian Ocean.
  - -- GLOSS - Establish absolute positions for remaining 60 of 100 GLOSS stations for altimeter calibration and long-term trends;
    - Complete the GLOSS core network from the present 180 to 270.
  - -- Argo - Complete implementation of the 3000 float array.
- Performance metrics to track progress toward implementation of the required in-situ observing system.

Observations Coordination Group Members

Rick Bailey, Chairman, Ship Observations Team (SOT)—***Rick is resigning and a replacement is needed.***
Graeme Brough, Chairman, Data Buoy Cooperation Panel (DBCP)
Karen Doublet, Additional Expert—***temporarily working with the Services Coordination Group.***
Hiroshi Kawamura, Satellite Rapporteur
Michael McPhaden, Chairman, Tropical Moored Buoys Implementation Panel (TIP)
Dean Roemmich, Chairman, Argo Science Team (AST)
Stan Wilson, Chairman, Observations Coordination Group (OCG)
Philip Woodworth, Chairman, Group Experts on Global Sea Level Observing System (GLOSS)
Zhouwen Yu, Additional Expert

Some Key Dates (please help keep this list up to date)

21 – 23 January 2002	VOSClim-III, Southampton
6 – 9 February 2002	MC-I – First meeting of Management Committee, Geneva
16 – 18 February 2002	Time Series Science-II, Honolulu
25 Feb – 2 March 2002	SOT-I Meeting, Goa
12 – 14 March 2002	Argo Science Team Meeting, Hobart
3 – 6 April 2002	JCOMM Services Coordination Group, Geneva

24 – 27 April 2002 OCG-I – First Meeting of JCOMM Observations Coordination Group, LaJolla
22 – 25 May 2002 JCOMM Data Management Coordination Group, Paris
3 – 6 July 2002 JCOMM Capacity Building Coordination Group, Geneva
14 – 24 October 2002 DBCP-XVIII and JTA-XXII, Martinique
2005 JCOMM-II – Second Meeting of JCOMM

Acronyms (used in the Table below)

MAN JCOMM Management Committee, co-chaired by Johannes Guddal and Sava Narayanan
DMCG Data Management Coordination Group, chaired by Wang Hong
ETDMP Expert Team on Data Management Practices, chaired by Nikolai Mikhailov; this is one of two Expert Teams under DMCG
RIC WMO Regional Instrument Center
CIMO WMO Commission for Instruments and Methods of Observation
ROSE Radar Ocean Sensing
POGO Partnership for Observing the Global Oceans

Item	Priority	Reference	Task	By whom	Target
Work plan	H	Para 13.3.2	Plan and oversee relevant JCOMM implementation activities in consultation with the GOOS Steering Committee.	MAN, OCG, **Chair**	Continuing
SOT Leadership	H		Identify a suitable successor to Rick Bailey as chair of the SOT.	MAN, OCG, **Chair, SOT**	**As soon as possible**
Instrumentation evaluation	H	Para 8.1.23 & 12.2.10	Consult with CIMO regarding the operation of RICs, with a view to preparing a more detailed proposal for JCOMM instrument evaluation and intercomparison procedures; prepare a proposal regarding procedures for evaluating and accrediting instrumentation and develop a mechanism to ensure that data collected by observing system operators conform to agreed on basic standards, formats and levels of data quality; discuss this proposal with the Management Committee.	MAN, OCG, **SOT**	Intersessional & JCOMM-II

Item	Priority	Reference	Task	By whom	Target
JCOMMOPS	H	Para 8.5.6	Consider the benefit and efficiencies that could be realized by extending the terms of reference of JCOMMOPS to include support for VOS and ASAP.	OCG, **SOT**	JCOMM-II
	M	Para 8.2.8	Address the funding of DCCP and SOOP Coordinator and make relevant proposals to the Observations Coordination Group for long-term funding.	**DBCP**, **SOT**	Intersessional
JCOMM observing components	H	Para 8.5.12	Advise JCOMM on the integration of new, non-physical observing components into the overall operational system.	MAN, OCG, **Non-physical rapporteur**	Continuing
	M	Para 8.2.21	Review the progress of the Argo project with a view towards a full integration into the JCOMM overall observing system at an appropriate time.	OCG, **AST**, DMCG and ETDMP	Intersessional
Performance measurement	H	Res. 16/3	(1) Develop performance metrics to measure progress toward meeting scientific requirements, delivery of raw data, measurement standards, logistics and resources; while performance measurement needs to be applied to the full system—from the collection of observations through the data system to the provision of services;	OCG **Chair**	Intersessional
			(2) Initially focus on tracking progress toward implementing the required components of the observing system.	OCG, **Chair**	As soon as possible
New technology	M/H	Res.16/3	(1) Review requirements and give advice on possible solutions, regarding trade-offs and use of new technique/developments.	OCG **Satellite Rapporteur**	Intersessional
		Para 8.3.24	(2) Review on an ongoing basis the status of CODAR with relevant worldwide ROSE groups, coordinating with Hans Graber of the University of Miami as the representative expert; and prepare appropriate technical guidance recommending the involvement of JCOMM.	OCG **Satellite Rapporteur**	ASAP Intersessional
GLOSS	M	Para 8.4.**11**	Provide advice to, and coordinate with, the GLOSS Technical Secretariat at IOC with regard to obtaining funding necessary to modernize and extend the GLOSS programme.	MAN, OCG, **GLOSS**	Intersessional

Item	Priority	Reference	Task	By whom	Target
Buoy	M	Para 13.1.4	Keep the matter of vandalism under review and suggest possible remedial actions, as and when feasible.	**TIP**	Continuing

Item	Priority	Reference	Task	By whom	Target
EUMETNET	M	Para 8.1.36	Arrange for appropriate cooperation and coordination with EUMETNET with regard to evaluation of all meteorological and oceanographic observations networks in Europe and surrounding ocean area.	**SOT**	Continuing
Requirements	M	Res. 16/3	Review and analyse requirements for ship-board observational data and coordinate actions to implement and maintain the network.	**SOT**	Continuing
Telecommun-ication facilities	M	Res. 16/3	Review marine telecommunications facilities and procedures for observational data collection, processing and transmission and propose actions for improvements.	**SOT**	Continuing
Instrumentation	M	Res. 16/3	Review and coordinate the implementation of new specialized shipboard instrumentation, siting and observing practices.	**SOT**	Continuing
Codes and formats	H	Para 7.4.5	Develop an appropriate practical solution regarding the difficulties of the on-board manual encoding of CREX messages, in consultation with CBS	**SOT**	Intersessional
	H	Para 7.4.11	Develop a common policy and approach to the application of Code 41, in particular which minimize restriction.	**SOT**	Intersessional
	M/H	Para 7.2.7	Investigate eventually transmitting full-resolution XBT data in BUFR code through GTS on a real time basis.	**SOT**	As soon as possible

Item	Priority	Reference	Task	By whom	Target
VOS	M/H	Res. 16/3 & Para 8.1.6	Support the development and maintenance of the VOSClim Project.	**SOT**/VOSP	Continuing
	M	Para 8.1.2	Consider the possibilities for some form of international award scheme for VOS.	**SOT**/VOSP	Intersessional
SOOP	M	Para 8.1.18	Identify upper ocean temperature and salinity data obtained by research institutes, but not available on GTS and ensure their quality control and timely distribution on the GTS; coordinate these activities with POGO.	**OCG, SOT**/SOOPIP and SOOP Technical Coordinator	Continuing
	M	Para 8.1.22	Review the use of TRACKOB and advise on its continuation.	**SOT**/SOOPIP	Intersessional
	M	Res. 16/3	Implement specific terms of reference.	**SOT**/SOOPIP	Continuing
ASAP	M	Para 10.11	Prepare additional technical information relating to ASAP and its benefit for distribution to Members/Member States.	**SOT**/ASAPP	Continuing
	M	Res. 16/3	Coordinate the overall implementation of the ASAP, including recommending routes and expand where possible.	**SOT/**ASAPP	Continuing

Annex XI

SOT Revised Terms of Reference

Ship Observations Team

The Ship Observations Team shall:

1. Review and analyze requirements for ship-based observational data expressed by relevant existing international programmes and/or systems and in support of marine services, and coordinate actions to implement and maintain the networks to satisfy these requirements;

2. Provide continuing assessment of the extent to which those requirements are being met;

3. Develop methodology for constantly controlling and improving the quality of data;

4. Review marine telecommunication facilities and procedures for observational data collection, as well as technology and techniques for data processing and transmission, and propose actions as necessary for improvements and enhanced application;

5. Coordinate PMO/ship greeting operations globally, propose actions to enhance PMO standards and operations, and contribute as required to PMO and observers training;

6. Review, maintain and update as necessary technical guidance material relating to ship observations and PMOs;

7. Liaise and coordinate as necessary with other JCOMM Programme Areas and expert teams, as well as with other interested parties;

8. Participate in planning activities of appropriate observing system experiments and major international research programmes as the specialist group on observations based onboard ships, including voluntary observing ships, ships-of-opportunity and research ships;

9. Seek for opportunities for deploying various kinds of measuring devices and widely publicize those opportunities;

10. Develop as necessary new pilot projects and/or operational activities and establish new specialized panels as required;

11. Carry out other activities as agreed by participating members to implement and operate the SOT programme and to promote and expand it internationally;

Terms of Reference of Component Panels

SOOP Implementation Panel

1. Review, recommend on and, as necessary, coordinate the implementation of specialized shipboard instrumentation and observing practices dedicated to temperature and salinity measurements;

2. Coordinate the exchange of technical information on relevant oceanographic equipment and expendables, development, functionality, reliability and accuracy, and survey new developments in instrumentation technology and recommended practices;

3. Ensure the distribution of available programme resources to ships to meet the agreed sampling strategy in the most efficient way;

4. Ensure the transmission of data in real time from participating ships; ensure that delayed mode data are checked and distributed in a timely manner to data processing centres;

5. Maintain, through the SOOP Coordinator, appropriate inventories, monitoring reports and analyses, performance indicators and information exchange facilities;

6. Provide guidance to the coordinator in his support for the SOOP;

7. Prepare annually a report on the status of SOOP operations, data availability and data quality

ASAP Panel

1. Coordinate the overall implementation of the ASAP, including recommending routes and monitoring the overall performance of the programme, both operationally and in respect of the quality of the ASAP system data processing;

2. As may be required by some members, arrange for and use funds and contributions in kind needed for the procurement, implementation and operation of ASAP systems and for the promotion and expansion of the programme;

3. Coordinate the exchange of technical information on relevant meteorological equipment and expendables, development, functionality, reliability and accuracy, and survey new developments in instrumentation technology and recommended practices;

4. Prepare annually a report on the status of ASAP operations, data availability and data quality

VOS Panel

1. Review, recommend and coordinate the implementation of new and improved specialized shipboard meteorological instrumentation, siting and observing practices, as well as of associated software;

2. Support the development and maintenance of pilot projects such as VOSClim;

3. Develop and implement activities to enhance ship recruitment, including promotional brochures, training videos, etc.

4. Prepare annually a report on the status of VOS operations, data availability and data quality

Annex XII

List of Action Items

OCG chair

para	action	With whom	time
3.15	Make continued close contact between JCOMM and POGO, through the Management Committee and also the Observations, Data Management and Capacity Building Programme Areas	Other PA chairs and Secretariat	
5.4(iii)	Review the first draft of an integrated system performance monitoring scheme	Other Team chairs	As soon as the draft is ready
7.2.1	Develop an outline and preparation plan for an integrated Implementation Strategy for the Observations Programme Area in time at least for submission to the second session of the Management Committee (Paris, February 2003).	With assistance of chairs of component teams and Secretariat	By MAN-II
7.3.1	Convey the proposed revised TOR for the Ship Observations Team to the next session of the JCOMM Management Committee, for approval on behalf of the Commission.	Secretariat.	At MAN-II
7.3.2	Arrange for representation at its meetings by both groups and programmes involving other types of observations in the future, as appropriate.	Secretariat	
7.3.2	Get future input on different regional data requirements and applications, including from the regional GOOS alliances.	Secretariat	
7.4.4.	Assess a feasibility study by JCOMMOPS Coordinator on accommodation of VOS data in JCOMMOPS	Secretariat	As soon as the results of the study are ready
7.5.4	Pass the proposal on amendment regarding wind reporting to the Management Committee	Secretariat	At MAN-II
7.5.5	Bring the draft implementation strategy for the OPA to the attention of the Management Committee	Secretariat	MAN-II
8.1	Decide exact dates and place of the second session of OCG in the first half of 2004	Secretariat	

Group members

para	action	Mainly by whom	With whom	time
2.1.6 (iii)	Provide the Secretariat with suggestions regarding a JCOMM logo.	Group members	Secretariat	
2.2.23	Make clear statements to satellite operators regarding the requirement for long-term continuity of ocean satellite observations of proven quality and operational/research value	Satellite rapporteur	co-presidents and Secretariat.	
3.6	Address the overall observational data requirements	Team chairs	DMCG	After the data require ments are reviewe d
5.4 (i)	Provide a single access point through JCOMMOPS to the existing individual system component monitoring results.	JCOMMOPS Coordinator	Component chair	
5.4 (i)	Provide relevant access information to the JCOMMOPS Coodinator	component chairs	JCOMOPS Coordinator	

para	action	Mainly by whom	With whom	time
5.4(ii)	Develop a first draft of an integrated system performance monitoring scheme	JCOMMOPS Coordinator, and MEDS (Bob Keeley)		
5.4(iii)	Review the draft of an integrated system performance monitoring scheme	OCG and team chairs	Secretariat	
6.11 (i)	Approach POGO to get data from research ships, especially on a real time basis	SOT	POGO	
6.13 (iv)	Enhance the shipboard report compilation and transmission software regarding wave observation practices	SOT Chair, Team members	Secretariat.	
6.13(v)	Prepare a technical report on Automated wave observations from ships, for possible eventual further action through VOSClim	Identified expert	SOT chair, VOSClim Project Leader	
6.17	Maintain instrument evaluations within the specialized panels. Recognize the need for evaluations to be properly resourced in the development of component data systems.	Observing system teams and panels	MAN	
7.4.4.	Make a feasibility study on accommodation of VOS data within JCOMMOPS	JCOMMOPS Coordinator	OCG chair Secretariat	
7.4.8	Work closely with the JCOMM Data Management Programme Area in further developing the system with regard to data buoys and the VOS.	JCOMMOPS Coordinator	DMCG	

Others

para	action	Mainly by whom	With whom	time
3.5	Undertake a detailed review of draft statement of Guidance as the draft becomes more developed. Review and update the WMO/CEOS database,specifically with respect to the observational data requirements for marine meteorological and oceanographic services	SCG		
3.15	Make continued close contact between JCOMM and POGO, through the Management Committee and also the Observations, Data Management and Capacity Building Programme Areas	PA chairs	Secretariat	
3.16	Prepare a brief report on prospects for emerging chemical and biological observations to MAN-II outlining specific next steps for moving JCOMM in this direction	Tony Knap		
3.6	Address the overall observational data requirements together with the component teams	DMCG	Component teams	
5.4(ii)	Develop a first draft of an integrated system performance monitoring scheme together with JCOMMOPS coordinator	Bob Keeley (MEDS)	JCOMMOPS Coordinator	
6.11 (i)	Make the real time transmission of such data routine to research vessel operators	POGO and the directors of participating institutions	SOT	
6.13(ii)	Facilitatethe distribution of wave and related data on the GTS (including issues relating to codes and formats)	DMCG		
6.14	Consider the possibility of designating a global network of in situ wave buoys, to provide the ground calibration segment for both satellites (altimeters) and wave models.	ETWS		
7.4.8	Work closely with the JCOMMOPS Coordinator in further developing the system with regard to data buoys and the VOS.	DMCG	JCOMMOPS Coordinator	

para	action	Mainly by whom	With whom	time
7.5.7	Develop liaison with POGO regarding its fellowship programme	CBCG	POGO Secretariat	

Secretariat

para	action	With whom	time
2.1.6 (iii)	Receive suggestions regarding a JCOMM logo from Group members	Group members	
2.2.23	Help satellite rapporteur and co-presidents make clear statements to satellite operators regarding the requirement for long-term continuity of ocean satellite observations of proven quality and operational/research value	Satellite rapporteur, Co-presidents	
3.15	Make continued close contact between JCOMM and POGO, through the Management Committee and also the Observations, Data Management and Capacity Building Programme Areas	PA chairs	
5.4(iii)	Distribute the draft of an integrated system performance monitoring scheme to the OCG chair and the chairs of the component teams for their review and input, prior to implementation.	JCOMMOPS Coordinator and MEDS OCG and team chairs	
6.10	Pass information regarding all its capacity building activities to the Capacity Building Coordination Group for consideration at the first session and incorporation into an overall JCOMM capacity building programme. (Geneva, June 2002)	CBCG	At CBCG-June 2002
6.13(i)	Consider arranging for the preparation of a status report on wave observations by coastal radars, as a first step in providing appropriate guidance to operational agencies		
6.13(iii)	Make arrangements to include wave observation practices in future training workshops on waves and surges		
6.13(iv)	Help SOT chair to enhance the shipboard report compilation and transmission software regarding wave observation practices:	SOT chair	
6.13(v)	Identify, in coordination with the chairman of the SOT, an appropriate expert to prepare a technical report on the issue of Automated wave observations from ships:, for possible eventual further action through VOSClim	SOT chair, VOSClim Project Leader	
6.14	Help ETWS consider the possibility of designating a global network of in situ wave buoys, to provide the ground calibration segment for both satellites (altimeters) and wave models.	ETWS	
7.1.2	Convey the request of the group to the Management Committee that information regarding available JCOMM data and products, as well as on key JCOMM web-sites, should included in the JCOMM brochure, which the Management Committee was currently preparing	Management Committee	
7.2.1	Help OCG chair develop an outline and preparation plan for an integrated Implementation Strategy for the Observations Programme Area in time at least for submission to the second session of the Management Committee (Paris, February 2003).	OCG Chair with assistance of chairs of component teams	By MAN-II
7.3.1	Convey the proposal on revised TOR for SOT MAN-II, for approval on behalf of the Commission. Chairman and	OCG chair	At MAN-II
7.3.2	Arrange for representation at its meetings by both groups and programmes involving other types of observations in the future, as appropriate.	OCG Chair	
7.3.2	Get future input on different regional data requirements and applications, including from the regional GOOS alliances.	OCG Chair	
7.4.4.	Assess a feasibility study by JCOMMOPS Coordinator on accommodation of VOS data in JCOMMOPS	JCOMMOPS Coordinator OCG chair	

para	action	With whom	time
7.5.4	Pass the proposal on amendment regarding wind reporting to the Management Committee	OCG chair	
7.5.5	Bring the draft implementation strategy for the OPA to the attention of the Management Committee	OCG chair	
7.5.7	Help the Capacity Building Coordination Group develop liaison with POGO regarding its fellowship programme, to enhance capacity to contribute to the overall observing system.	CBCG POGO	
8.1	Decide exact dates and place of the second session of OCG in the first half of 2004	OCG chair	

Annex XIII

List of Acronyms and Other Abbreviations

ALT	(subset for calibrating satellite) altimeters (GLOSS)
AOPC	Atmospheric Observations Panel for Climate
ASAP	Automated Shipboard Aerological Programme
AST	Argo Science Team
BATHY	Bathythermograph report
BLA	Boundary Layer of the Atmosphere
BUFR	Binary Universal Form for Representation of Meteorological Data
BUOY	Report for Buoy Observations (GTS)
CBCG	Capacity Building Coordination Group (JCOMM)
CBS	Commission for Basic Systems (WMO)
CEOS	Committee on Earth Observation Satellites
CGMS	Coordination Group for Meteorological Satellites
CLIVAR	Climate Variability and Predictability (WCRP)
CLS	Collecte Localisation Satellites
CMM	Commission for Marine Meteorology (WMO)
CoML	Consensus of Marine Life
COOP	CLIVAR Ocean Observations Panel
COOP	GOOS/Coastal Ocean Observing Panel
CREX	Character code for the Representation and Exchange of meteorological and other data
DAC	Data Assembly Centre (VOSClim)
DBCP	Data Buoy Cooperation Panel (WMO-IOC)
DMCG	Data Management Coordination Group (JCOMM)
DORIS	Doppler Orbitography and Radiopositioning Integrated by Satellite
E-ASAP	Eumetnet ASAP Project
EC	Executive Council
ECMWF	European Centre for Medium-Range Weather Forecasting
ETWS	Expert Team on Wind Waves and Storm Surges
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
FNMOC	Fleet Numerical Meteorology and Oceanography Center (US Navy)
FRX	Frequently repeated XBT (FRX) (lines)
GCN	GLOSS Core Network
GCOS	Global Climate Observing System
GDAC	Global Data Assembly Centers (Argo).
GDSIDB	Global Digital Sea Ice Data Bank
GIS	Geographic Information System
GLOSS	Global Sea-Level Observing System
GMDSS	Global Maritime Distress and Safety System
GODAE	Global Ocean Data Assimilation Experiment
GOOS	Global Ocean Observing System
GOS	Global Observing System (WWW)
GPS	Global Positioning System
GTS	Global Telecommunication System (WWW)
GTSPP	Global Temperature Salinity Profile Programme
HRX	High Resolution XBT/XCTD (transact)
IFREMER	Institut Francais de Recherche pour l`Exploitation de la Mer
ICSU	International Council for Science
IGOS	Integrated Global Observing Strategy
IGOSS	Integrated Global Ocean Services System
IHO	International Hydrographic Organization
IMO	International Maritime Organization
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IODE	International Data and Information Exchange (IOC)

JAMSTEC	Japan Marine Science & Technology Center
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
JCOMMOPS	JCOMM in situ Observing Platform Support Centre
LTT	(subset for studying) Long Term Trends (GLOSS)
LUT	Local User Terminal
MCSS	Marine Climatological Summaries Scheme
MPERSS	Marine Pollution Emergency Response Support System
NASA	National Aeronautics and Space Administration (USA)
NASDA	National Space Development Administration (Japan)
NAYLAMP	El Nino Annual Y Las Anomalias Medidas en el Pacifico
NCEP	National Centers for Environmental Prediction (NOAA)
NESDIS	National Environmental Satellite, Data and Information Service (NOAA)
NMS	National Meteorological Service
NOAA	National Oceanographic and Atmospheric Administration (USA)
NWP	Numerical Weather Prediction
OC	(subset for monitoring key) ocean circulation (indices) (GLOSS)
OceanObs	International Conference on the Ocean Observing System for Climate
OCG	Observations Coordination Group (JCOMM)
ODAS	Ocean Data Acquisition Systems
OGP	Office of Global Programmes (NOAA)
OOPC	Ocean Observation Panel for Climate (of GOOS, GCOS, WCRP)
OOSDP	Ocean Observing System Development Panel
PIRATA	Pilot Research Moored Array in the Tropical Atlantic
PMEL	Pacific Marine Environmental Laboratory
PMO	Port Meteorological Officer
POGO	Partnership for Observations of the Global Ocean
QA	Quality Assurance
QC	Quality Control
R&D	Research and Develpment
ROSE	Radar Ocean Sensing
SCG	Services Coordination Group (JCOMM)
SCOR	Scientific Committee on Oceanic Research
SHIP	Report of Surface Observation from Sea Station
SIO	Scripps Institution of Oceanography (USA)
SLP	Sea Level Pressure
SOOP	Ship-of-Opportunity Programme
SOOPIP	JCOMM Ship-of-Opportunity Programme Implementation Panel
SSH	Sea Surface Heights
SSS	Sea Surface Salinity
SST	Sea Surface Temperature
SVP	Surface Velocity Programme
TAO	Tropical Atmosphere Ocean Array
TEMP	Upper-level temperature, humidity and wind report from a land station
TESAC	Temperature, Salinity and Current Report
TIP	Tropical Moored Buoy Implementation Panel
TOR	Terms of Reference
TRACKOB	Code for reporting marine surface observations along a ship's track
TRITON	Triangle Trans-Ocean Buoy Network
UN	United Nations
UNEP	United Nations Environment Programme
UNOLS	University-National Oceanographic Laboratory System (USA)
UOP	Upper Ocean Panel (CLIVAR)
VOS	Voluntary Observing Ship
VOSClim	Voluntary Observing Ships Climate Subset Project
WCP	World Climate Programme (WMO)
WCRP	World Climate Research Programme (WMO/IOC/ICSU)
WRAP	Worldwide Recurring ASAP Project

WWW	World Weather Watch (WMO)
XBT	Expendable Bathythermograph
XCTD	Expendable conductivity-temperature-depth probe
XML	Extendable Mark-up Language

OOPC and OCG, April 2002

* OOPC Pilot Projects
* Other OOPC Initiatives
* OceanObs99 St. Raphael
* CEOS/IGOS Ocean Theme
* Toward a products/system approach
* Data quality issues
* GODAE & CLIVAR and upper ocean thermal, salinity & circulation

OOPC Pilot Projects

- Global Ocean Data Assimilation Experiment (http://www.bom.gov.au.godae)
- ARGO (http://www.argo.ucsd.edu)

* Global Ocean Time Series Observatories System (w. POGO)

OOPC - Other Initiatives

- Surface Marine Fields – VOSCLIM and data transmission and surface reference sites
- Ship of Opportunity Program - into non-physical measurements
- SST – Sea Ice Expert Team (w. AOPC)
- Surface Pressure Expert Team (w. AOPC)

OceanObs99 St Raphael

- International ocean operations and research communities came together to reach consensus on ‘next steps’ in sustained ocean observations.
- “Observing the Oceans in the 21st Century” available from Bureau of Meteorology, Melbourne, Aus. (N.Smith @bom.gov.au).
- JCOMM and OCG are crucial for much.

Maximize Data Quality

- We have opportunity to do better with our routine observations

- Climate signals often are not large (fig.)
- Ship surface temperatures continue to show large scatter.
- Ship based obs. of surface meteorology variables also show large scatter.
- High SLP quality requires careful effort
- Real time reporting is highly desirable for all routine obs.

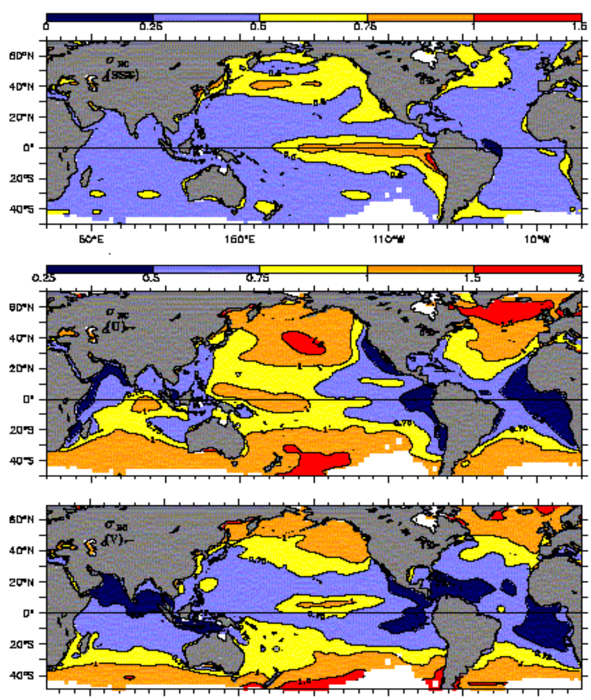
CLIMATE ANOMALY STANDARD DEVIATIONS

COADS, 1946-1995

RC-Smoothed

Harrison & Larkin, 1998

Reviews of Geophys.



SST

(C)

Zonal

Wind

(m/s)

Merid

Wind

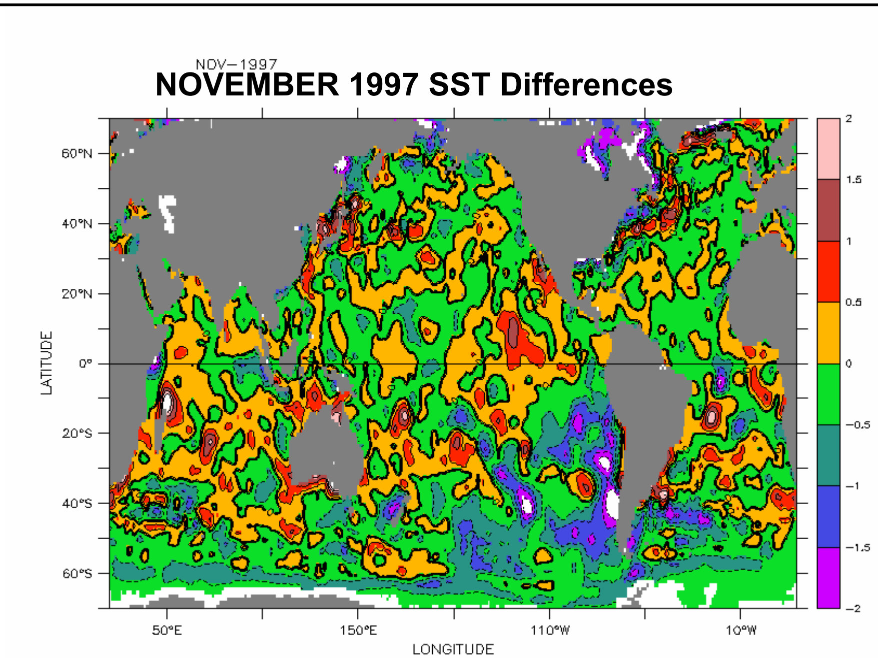
(M/S)

SST Expert Group

- Intercomparison of global SST products identified significant differences, relative to large-scale climate signal amplitudes
- GCOS & GOOS established an "Expert Team" lead by Dick Reynolds, with international participation
- Many operational SST products are available via an LiveAccesServer:

  http://ferret.wrc.noaa.gov/reynolds

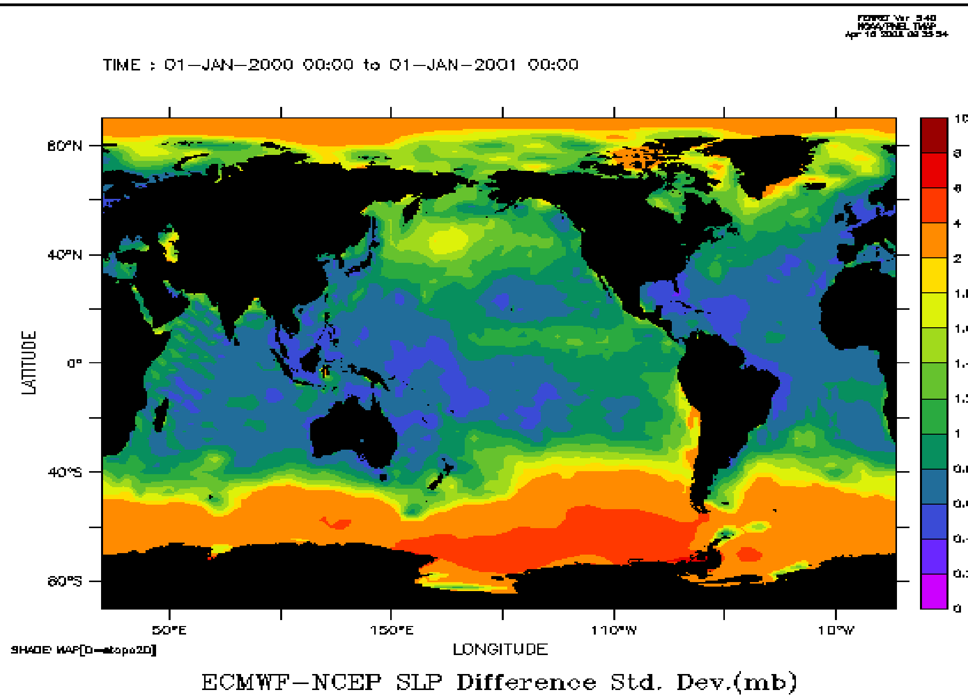
Work is underway to identify data needs and improve operational procedures.



NCEP minus UKMET SST Products

Surface Pressure Expert Group

- Surface pressure (SLP at sea) is a key climate variable
- Also a key input for Sea Surface Height Anomaly estimation
- Intercomparison of SLP operational products has begun
- Evaluation of historical SLP data set is also underway



Toward a Product/System Approach

- To meet the objectives of the customers of the IOOS, a *product, product skill and product improvement focus* is called for.
- The quality of each observation remains of paramount importance- Need uncertainty estimate for each observation
- Also need appropriate global data distributions
- A system approach uses product skill evaluation to guide our implementation choices and priorities

Product skill goals (TBD)

* SLP to 0.5mb, 2x2deg, daily
- SST to 0.1C, 5x5deg, weekly
- Upper ocean regional volume average temperature to 0.1C, monthly
- Net meridional heat transport across repeat sections to 0.1 Petawatt, seasonally
- Ocean carbon inventory changes to 0.2gton/yr over five year repeats

CEOS and its Themes

- Commission on Earth Observation Satellites (CEOS)
- Integrated Global Observing Strategy (IGOS)
- IGOS Themes:
  - Ocean Theme
  - Carbon Theme
  - http://www.ceos.org/pages/igosopen.html

GODAE

- The Global Data Assimilation Experiment has the goal of demonstrating the utility of a wide suite of operational oceanography products
- Intensive Period is 2003-2005
- Data systems are in pilot implementation phase
- Data & Product Server/Browsers available:
  e.g., http://www.usgodae.fnmoc.navy.mil/

The real time component and 'climate' component, have different data quality needs and time constraints

Need to characterize data errors for ODA

CLIVAR Sustained Ocean Obs

- CLIVAR is planning new field programs in each of the ocean basins.
- Although these will be research programs, all available platforms and sensors will be needed for best outcome
- Development of "AUVs", including gliders
- Will help us understand better the scales and mechanisms of climate phenomena

The Next Few Years

- GODAE needs real time data, real time QC, good data access.
- Lots of the World Ocean still not well sampled – global coverage is needed routinely.
- ARGO to full implementation.
- Improve quality of sustained data.
- CLIVAR is planning regional efforts.
- Work together to develop:
  - optimum regional mix of sensors and data, relative to the variability in each region,
  - to reach our product skill goals

Annex VIII


Building a Sustained Ocean Observing System for Climate
Altimeter and Scatterometer
3°x3° Argo Float Array
Volunteer Observing Ships
Ocean Reference Stations
Research Ships
5° x 5° Drifting Buoy Array
Moored Arrays
Tide Gauge Stations
Global Ocean Observing System for Climate and Marine Services
Initial Ocean Observing System Milestones
Phased Implementation Plan, including international contributions

Ten-year Implementation Plan

For

Building a Sustained Ocean Observing System for Climate

Updated: August 2001
NOAA Office of Global Programs

Executive Summary

NOAA is committed to the task of building and sustaining a global climate observing system to meet the long-term observational needs of the operational forecast centers, international research programmes, and major scientific assessments. This paper describes a 10-year implementation plan for building the ocean component of that system.

Central to this effort is the opportunity and necessity for international collaboration. A global observing system by definition crosses international boundaries and the potential exists for both benefits and burdens to be shared by many nations. The plan reflects that reality.

Of equal importance is the need to coordinate across agencies within the United States. It is recognized that an effective global ocean observing system can be achieved only through continuing interaction among all national (and international) partners. In this context, NOAA's effort will provide a long-term component of the composite observing system to complement the contributions of the other ocean agencies.

The strategic approach underlying this implementation plan is as follows:

- Build the long term ocean component of the observing system in the context of a comprehensive, multi-year, climate services initiative. Improved marine and coastal forecast services will be immediate byproducts.
- Set a 2000-2010 time line for phased implementation.
- Establish accountability for the ocean component of the observing system by defining specific objectives and performance measures.
- Define an "initial observing system" that will accomplish the objectives and performance measures. Identify annual milestones to complete the initial observing system over the ten-year time line. Emphasize that the initial system is our best guess at this time – it must be evolutionary.
- State the obvious – a global observing system can not be built with existing budgets. Estimate the annual funding needed to achieve the identified milestones. Estimate that NOAA will implement about 50% of the global system.
- Work pro-actively with national and international partners to achieve 100%.

Although NOAA's marine and coastal services and the mission services of the other agencies and nations will benefit from this plan, and are considered throughout, accomplishing NOAA's climate mission is the fundamental driver. The scientific foundations come from the Climate Variability and Predictability Program (CLIVAR), the Carbon Cycle Science Program, and the Global Water Cycle Program. It is not the intent of the plan to provide all of the observations needed by these programmes but to provide a baseline observing system, to be sustained over the long term, that can be built upon where needed to solve specific questions. This baseline system looks for efficiencies to be gained by utilizing common platforms/sites/data infrastructure for several objectives in parallel, and seeks to foster a system approach to effective international organization of complementary in situ, satellite, data, and modeling components of climate observation.

The initial system design objectives (performance measures) are established as:

- For the global ocean, deliver four times daily analyses of sea surface pressure, sea surface wind, and marine weather and sea state conditions.
- For the global tropics, deliver daily analyses of precipitation, sea surface temperature, and air-sea fluxes.
- For the global ocean, deliver weekly analyses of upper ocean temperature and salinity, sea surface temperature and currents, and sea level.
- For the global ocean, deliver an ocean carbon inventory once every 10 years, and seasonal (four times yearly) analyses of the variability of ocean-atmosphere carbon exchange.
- At fixed climate reference stations, document long term trends in sea level change, and ocean/atmosphere variability.

In order to meet these objectives, the plan draws upon the observational experience gained in building the ENSO observing system in tropical Pacific, and upon the international design of *The Ocean Observing System for Climate* (Saint-Raphael, France, 1999). Again, this plan does not seek to implement all aspect of the Saint-Raphael system, but only those base-line components needed to meet the design objectives, and those for which NOAA should expect to have primary mission responsibility in the United States. The initial system (emphasizing adjustable and evolutionary) is comprised of twelve complementary in situ, space based, data and assimilation subsystems:

1. Global Tide Gauge Network
2. Global Surface Drifting Buoy Array
3. Global Ships of Opportunity Network
4. Tropical Moored Buoy Array
5. Argo Profiling Float Array
6. Coastal Moored Buoy Arrays
7. Ocean Reference Stations
8. Ocean Carbon Monitoring Network

9. Satellite Altimeter
10. Satellite derived Surface Vector Winds (Scatterometer)
11. Research Ship Operations
12. Data and Assimilation Systems (the Global Ocean Data Assimilation Experiment – GODAE)

A phased plan for systematically extending these networks to provide the needed global coverage is laid out with the following milestones targeted:

- Implement Argo, increasing the global array from the present 620 floats to the designed 3000 float array (by 2004).
- Expand the global SST/velocity drifter array from 800 to 1250 buoys (by 2004), and add pressure, wind, and precipitation measurement capabilities to all oceans.
- Install permanent GPS receivers at 86 select tide gauge stations -- the present network contains 45 GPS stations (by 2006).
- Implement a global network of ocean reference station moorings, expanding from the present two pilot flux stations to a permanent network of 16 (by 2006).
- Rejuvenate the U.S. coastal mooring network and assist South American countries in establishing their coastal moorings bringing the international array to 114 stations from the present 85 (by 2006).
- Expand the tropical moored buoy network from 77 to 106 stations spanning all three oceans (by 2007).
- Expand ships-of-opportunity high-resolution ocean and atmospheric sampling from the present 17 lines to 22 lines, and collapse the present broadcast XBT network into 19 frequently repeated lines (by 2007).
- Add autonomous carbon dioxide sampling to the moored arrays and the VOS fleet, and implement an ongoing ocean carbon inventory that will survey the entire globe once every 10 years (by 2007).
- Utilize international GODAE to develop an operational capability for routine assimilation of ocean data into forecast and climate prediction models, and provide a free and open global data management system for all ocean climate information (by 2007).
- Transition the U.S. partnership in altimeter operations from NASA to NOAA (by 2008).
- Systemize routine climate observations aboard the U.S. and international research fleets (by 2009).
- Transition the U.S. partnership in scatterometer operations from NASA to NOAA by 2010).

These subsystems in their present state comprise about 25% of what will be needed to complete the initial global observing system. As noted above, it is not expected that this system can be completed with existing resources. A significant National investment will be required by the United States, as well as a significant commitment to growth by our international partners. It is estimated that in the year 2000, at the outset of this effort, the international community was spending about $108 million annually, to which NOAA was contributing $26 million. By the year 2010 when the initial system will be fully in place, NOAA must plan to contribute $142 million annually to an international effort of $265 million.

Introduction

NOAA context: In FY 2000, NOAA embarked on a multi-year Climate Services Initiative with the goal of building a national capability to routinely deliver climate forecasts and assessments of economic value. The initiative is designed as a phased plan to build a complete suite of climate services over ten years. Central to this effort is the task of implementing a sustained global climate observing system. This paper describes one element of that task - a 10-year plan for phased implementation of the ocean component of the observing system. The objective is to meet NOAA's climate mission requirements - to provide the sustained ocean observing system needed to support climate forecasting, assessments, and directed research.

Interagency context: At the same time the observing system must be advanced in support of climate services, it must also be advanced in response to a national demand for the ocean agencies to coordinate implementation of the U.S. contribution to the global ocean observing system. It is recognized that an effective global ocean observing system can be achieved only through continuing interaction among all national (and international) partners. In this context, NOAA's climate contribution will provide a long-term component of the composite observing system that complements the contributions of the other ocean agencies. Implementation will be coordinated with the National Oceanographic Partnership Program agencies, just as all of NOAA's climate observation and research activities have been coordinated through the U.S. Global Change Research Program for the past decade.

International context: The observational component of climate services has by far the greatest opportunity and necessity for international collaboration. A global observing system by definition crosses international boundaries and the potential exists for both benefits and burdens to be shared by many nations. The climate system described below is based upon the international design of, and is an U.S. contribution to, *The Ocean Observing System for Climate* (Saint-Raphael, France, 1999). The observing system projects that make up the climate component have been developed, and will continued to be evolved, organized and managed, in cooperation with the international implementation panels of the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology.

Ocean Observing System for Climate

This plan for implementation of a sustained ocean component of the observing system includes: 1) deployment and maintenance of observational platforms and sensors, both remote and in situ; 2) data delivery and management; and 3) routine delivery of ocean analyses. This end-to-end ocean system will provide the critical “up-front” information needed for climate forecasting, research, and assessments – continuous, long term, climate quality, global data sets and a suite of routinely delivered ocean analyses. At the same time, the system will provide real-time data to serve the needs of NOAA’s marine and coastal forecast missions and the needs of the other agencies in accomplishing their missions.

The initial design objectives are:

- For the global ocean, deliver four-times-daily analyses of sea surface pressure, sea surface wind, and marine weather and sea state conditions.
- For the global tropics, deliver daily analyses of precipitation, sea surface temperature, and air-sea fluxes.
- For the global ocean, deliver weekly analyses of upper ocean temperature and salinity, sea surface temperature and currents, and sea level.
- For the global ocean, deliver an ocean carbon inventory once every ten years, and deliver seasonal (four-times-yearly) analyses of the variability of ocean-atmosphere carbon exchange.
- At fixed climate reference stations, documented long term trends in sea level change and ocean/atmosphere variability.

A strong scientific basis must underpin the implementation and continued improvement of the ocean observing system for climate. The system must be long-term and stable, but not static. The future will bring better understanding of climate and other ocean requirements, and new awareness of better sampling techniques, methods, and trade-offs between data and numerical models. Consequently, the ongoing, central involvement of the research community is essential to maintaining an ocean system that is dynamic and responsive, even as it is continuing. An institutional commitment to this blend of research and operations is central to NOAA’s programme.

The scientific drivers for this plan derive from three global research programmes – the Climate Variability and Predictability Program (CLIVAR), the Carbon Cycle Science Program, and the Global Water Cycle Program. These programmes have developed comprehensive science plans that specify observational requirements. Each programme is coordinated in the U.S. by an interagency working group that in turn coordinates internationally. The elements of this NOAA 10-year plan are not intended to satisfy all of the observation requirements of these programmes, rather they are intended to provide a backbone infrastructure to be sustained over the long term for climate service applications, a backbone that can built upon where research requires. Additionally, the elements of this plan are those that can promote efficiencies through the use of common platforms/sites/data infrastructure for several objectives in parallel.

The three general classes of activities within the ocean observing system for climate - operation of in situ and space networks, data and information management, and ocean analysis - must be complemented by the technology development needed to improve the entire system. Although, these activities are typically listed independently, it is critical to recognize that an integrated observing system is proposed -- integrated in the sense that sensors and networks are multi-purpose, remote and in situ data are combined, data management is multi-dimensional in data access and product generation, assimilation into the models uses multiple data types, and the over arching goal of the observing system is to effectively serve multiple research, forecast, and assessment objectives.

Specifically, past research and operational advances clearly demonstrate that a multi-platform/sensor system is crucial for accurate forecasts, increased understanding of the climate system and accurate detection, attribution and assessment results. Each network brings its own strengths and weaknesses to the system. None can do the job alone. Although satellites provide global coverage with spatial resolution typically not available from in situ networks, data from the latter networks are needed to calibrate, validate and interpret data from the former. Furthermore, experiments with climate models show that initializing the ocean components of the forecast models with combined remote and in situ data vastly improves the initialization process.

NOAA's climate contribution to the global ocean observing system will focus on those networks that can deliver data in real time and of the highest possible accuracy so that the observations are suitable for forecasting and analysis at all time scales from immediate marine weather conditions to seasonal climate variability to long term climate change. Implementation of the in situ networks will be through distributed centers of expertise at the NOAA laboratories, the National Data Buoy Center, and the university laboratories that have developed the instruments and techniques. The space components will be centered in the National Environmental Satellite Data and Information Service. The focal point for developing global ocean data assimilation capabilities will be the Geophysical Fluid Dynamics Laboratory in partnership with university-based applied research centers. Specific components and aspects of this end-to-end observing system are described below. The composite system is illustrated in Figure 1.

Figure 2 is a graphic representation of the phased, 10-year implementation strategy. Achievement of the annual milestones and the network goals described below will depend upon the success of the multi-year budget initiative process in producing the necessary resources. Cost estimates for the NOAA, interagency, and international contributions to this climate component of the ocean observing system are summarized in Figure 3 and are detailed in Table 1. The numbers listed are intended to indicate the magnitude of the work to be done and are based on the best estimates presently available. It should be emphasized, however, that the observing system must be evolutionary, and that the design objectives will change over the 10-year term of this initiative as research, forecasting, and assessment experience advances.

Tide Gauge Network: Tide gauges are necessary for accurately measuring long-term trends in sea level change and for calibration and validation of the measurements from satellite altimeters which are assimilated in to global climate models for predicting climate variability. Many tide stations need to be upgraded with modern technology.

Additionally, permanent GPS receivers will be installed at a selected subset of stations, leading to a climate network expansion from the present 45 GPS sites to 86 sites globally by 2006.

Drifting Buoy Array: Data sparse regions of the global ocean are a major source of uncertainty in the seasonal forecasts and are also a major uncertainty in the detection of long term trends in global sea surface temperature, which in turn is an indicator of global change. Data gaps must be filled by surface drifting buoys to reduce these sources of error to acceptable limits. NOAA, together with international partners, will extend the global SST/velocity drifting buoy array to data sparse regions, increasing from 800 to 1250 buoys by 2004, while adding wind, pressure, and precipitation measurement capabilities to serve short term forecasting as well as climate research, seasonal forecasting, and assessment of long term trends.

Tropical Moored Buoy Network: The advanced understanding of the role of the tropics in forcing mid-latitude weather and climate was learned primarily through the observations of the tropical moored buoy array (TAO/TRITON) in the Pacific. A similar pilot array in the Atlantic basin (PIRATA) now offers the potential of even better understanding, improved forecasts, and improved ability to discern the causes of longer term changes in the Oceans. The global tropical moored buoy network will be expanded from 77 to 106 stations by 2007 and will ultimately span all three oceans - Pacific, Atlantic, and Indian Ocean.

Volunteer Observing Ships: The global atmospheric and oceanic data from ships of opportunity have been the foundation for understanding long-term changes in marine climate and are essential input to climate and weather forecast models. Improved instrument accuracy, automated reporting, and improved information about how the observations were taken will greatly enhance the quality of these data, reducing both systematic and random errors. NOAA will improve meteorological measurement capabilities on the global VOS fleet for improved marine weather and climate forecasting in general, and will concentrate on a specific subset of high accuracy VOS lines to be frequently repeated and sampled at high resolution for systematic upper ocean and atmospheric measurement. This climate-specific subset will build from 23 lines presently occupied to a designed global network of 42 lines by 2007 and will provide measurements of the upper ocean thermal structure, sea surface temperature and chemistry, and surface meteorology of high accuracy for documentation of ocean-atmosphere exchanges of heat, water, and carbon dioxide.

Argo array of profiling floats: The heat content of the upper 2000 meters of the worlds oceans, and the transfer of that heat to and from the atmosphere, are variables central to the climate system. The ocean provides the “memory” that influences the differences that are seen in seasonal weather patterns from year to year. The Argo array of profiling floats is designed to provide essential broad-scale, basin-wide monitoring of the upper ocean heat content. Three thousand floats will be deployed worldwide by 2004. The U.S. contribution is approximately one-third of this international project.

Ocean Reference Stations: NOAA, together with international partners, will implement a global network of ocean reference station moorings, expanding from the present two pilot stations to a permanent network of 16 by 2006. Many of these new ocean moorings will be located at the historical sites of the former Ocean Weather Ship stations. The records from these abandoned sites have been invaluable is studying ocean atmosphere exchange and long term trends in ocean climate. Re-establishing the sites with modern technology (autonomous moorings instead of manned ships) will allow the historical records to be extended into the future and will also add calibration/validation points to the global in-situ and remote networks for improved climate and marine forecasting.

Coastal Moorings: Improved near shore measurements from moored buoys are critical to coastal forecasting as well as to linking the deep ocean to regional impacts of climate variability. Furthermore, the coastal regions are critical to the study of the role of the ocean in the intensification of storms which are key to the global transport of heat, momentum and moisture, and are a significant impact of climate on society. Coastal arrays are maintained by many nations making this a “global” network of “coastal” stations. NOAA’s existing network will be improved by augmenting and upgrading the instrument suite to provide measurements of the upper ocean as well as the sea surface and surface meteorology.

Ocean Carbon: Understanding the global carbon cycle and the accurate measurement of the regional sources and sinks of carbon are of critical importance to international policy decision making as well as to forecasting long term trends in climate. Projections of long term global climate change are closely linked to assumptions about feedback effects between the atmosphere, the land, and the ocean. To understand how carbon is cycled through the global climate system, ocean measurements are critical. NOAA will add autonomous carbon dioxide sampling to the moored arrays and the VOS fleet to analyze the seasonal variability in carbon exchange between the ocean and atmosphere, and will implement a programme of systematic global ocean surveys that will provide a complete carbon inventory once every ten years.

Platform Support: Ship time within the UNOLS research fleet for deployment of the moored and drifting arrays, and for deep ocean surveys is an essential component of this initiative. The deep ocean can not be reached by VOS and Argo; yet quantification of the carbon and heat content of the entire ocean column is needed to solve the climate equations. In addition to providing the survey and deployment platforms for the autonomous arrays, the research fleet will maintain sensor suites on a small core of these vessels as the highest quality calibration points for validation of the other system measurements.

Altimeter: The value of spaced-based altimeter measurements of sea level height has now been clearly demonstrated by the TOPEX/ Poseidon and Jason missions. Changes in sea level during major El Nino events can now be discerned at high resolution affording more realistic model initializations for seasonal climate forecasting. NOAA must now take on the role of ensuring that these altimeter data become part of the routine long-term set of climate observations by beginning the transition of the U.S. partnership in altimeter operations from NASA to NOAA, to be completed by 2008.

Scatterometer: An aggressive satellite ocean winds observation programme, coupled with the greater number of *in situ* wind observations planned for the ocean system, is necessary for improved understanding of climate process as well as improved forecasting of both climate and marine weather events. As a first step NOAA will establish a science team to serve as a focal point for cooperative research on ocean winds with the immediate goal of developing ocean wind data assimilation techniques for numerical weather and ocean prediction models to serve both short-term marine forecasting needs and climate predictions. The long-term goal will be to transition proven ocean wind sensing capability (e.g. scatterometry) to an operational satellite system by 2010.

Data Management: A robust and scalable data management infrastructure is essential to the vision of a sustained ocean observing system. The value of the observations does not end with their initial use in detecting and forecasting climate variability. The data must be retained and made available for retrospective analyses to understand long term climate change, and for designing observing system operations and improvements. NOAA's long history and unique expertise in environmental data management will be applied to the ocean observing system. NOAA also will include the vast holdings of historical ocean observations within the context of the integrated environmental data access and archive system. Support will also be provided for a World Ocean Database to incorporate modern data into an integrated profile system.

Ocean Analyses: For climate and marine forecasting, the combined fields from many different networks are used as initial conditions to begin the forecast. These combined fields, or analyses, are used to document what the ocean and atmosphere are doing at present and what they did in the past (if sufficient historical data are available). By routinely comparing models and data, shortcomings in the observing system can be identified and both the models and forecasts can be improved. To utilize effectively the ocean observations, NOAA will expand the current ocean analyses (presently focused on the tropical Pacific) to the global domain and will develop and implement improved assimilation systems that can more effectively use the new data types that are being collected. The principal vehicle for doing this, involving both national and international communities and producing a variety of marine products in addition to the use of these observations in forecast systems, will be the Global Ocean Data Assimilation Experiment (GODAE).

Observing System Targeted Research: The ten-year implementation plan and activities outlined here represent a best estimate of an initial ocean observing system for climate. But this initial system must evolve as understanding of the climate system advances, technology improves, and numerical models improve. In addition to supporting the research, forecasting, and assessment requirements of climate services, the observations resulting from these global arrays will be used for applied studies to make the observing system and its products more effective. Sampling strategies will be evaluated to ensure the most efficient and effective combination of remote and in site measurements. Through data syntheses and assimilation processes, the targeted research will constantly evaluate the observing system products that result from the combination of the data streams in order to ensure that the best ocean analyses are produced. The research will ensure that the most effective quality control is done, that new technology is implemented once it is ready, and that duplicative or out dated activities are minimized.

Interagency/International Strategy

This plan includes elements that fall principally under NOAA's mission responsibilities for implementation within the United States. As noted throughout, however, the plan depends critically on interagency and international collaboration. Figures 1, 2, and 3, and Table 1 reflect the composite interagency/international system. The general strategy of this plan assumes that NOAA will implement approximately 50% of the system over the next 10 years. This means that NOAA will "buy out" NASA's share of the operational satellite missions (these missions are international partnerships). This buy-out represents the largest decrease in interagency funding illustrated in Figure 3. Continued partnership with NSF and the Navy is required in supporting in situ ship operations, carbon monitoring, and deployment of the drifting arrays; this is the interagency contribution that continues across the entire ten years in Figure 3. All of the in situ networks require international partnerships and success in implementing the ocean observing system for climate will depend on the entire international community ramping up over the next decade.

Benefits

The data and analyses deliverables noted above (the initial design objectives) are of limited value in-and-of themselves -- the data and analyses must be converted to information that is of economic value to the Nation by the forecast, assessment, and research components of NOAA's climate me. At the same time, the forecast, assessment, and research components can not do their jobs without receiving accurate data and analyses from the observing system. The benefits outlined below are achieved only through a complete climate service of all four elements: observation, research, forecasting, and assessment.

Seasonal variability: The last several years have graphically demonstrated the vulnerabilities of social and economic systems to natural climate variability. During the 1997/98 El Nino, impacts were felt in agriculture, the energy sector, transportation, retail, ecosystem disruptions, public health, property damage, extreme weather events, to name a few. Estimates suggest that the impacts were of the order of billions of dollars in several of these sectors just in the U.S. The seasonal forecasts are now being used by managers in most of these sectors. Mitigation efforts, based on the NOAA forecast, by FEMA and local emergency management agencies in California alone are estimated to have reduced losses by perhaps $1 billion. Forecasts were also used internationally to help mitigate the global impacts of that powerful El Nino event. The U.S. economy (and indeed the global economy) is vulnerable to climate variability. The energy and retail sectors were the first to quantitatively use climate forecast information (which depends directly on a global observing system). The weather derivatives market is now estimated to be several billion dollars and can be expected to grow. It has been estimated that roughly 20% of the $9 trillion U.S. economy is sensitive to weather and climate variability. This suggests that with improved forecasts, understanding, and action partnerships with end users, the advantage to the U.S. economy can be enhanced of order 10's of $ billions.

Long term climate variability and change: Changes in oceanic heat transport from the tropics to the poles, regime shifts in ocean productivity, and changes in atmospheric circulation related to long-term changes in the ocean have affected and will affect societies in general. Improved documentation and analysis of long term variability in ocean properties and fluxes will provide the information needed for society to anticipate and adapt to the general changes in the earth’s climate system that will result. Improved estimates of the oceanic burden of CO2 will assist decision-makers in establishing national policy for adapting to climate change. Accurate documentation and forecasting of sea level change are crucial to engineering and land use decisions as the U.S. population continues to migrate to the nation’s coastal regions.

Global Ocean Observing System for Climate and Marine Services

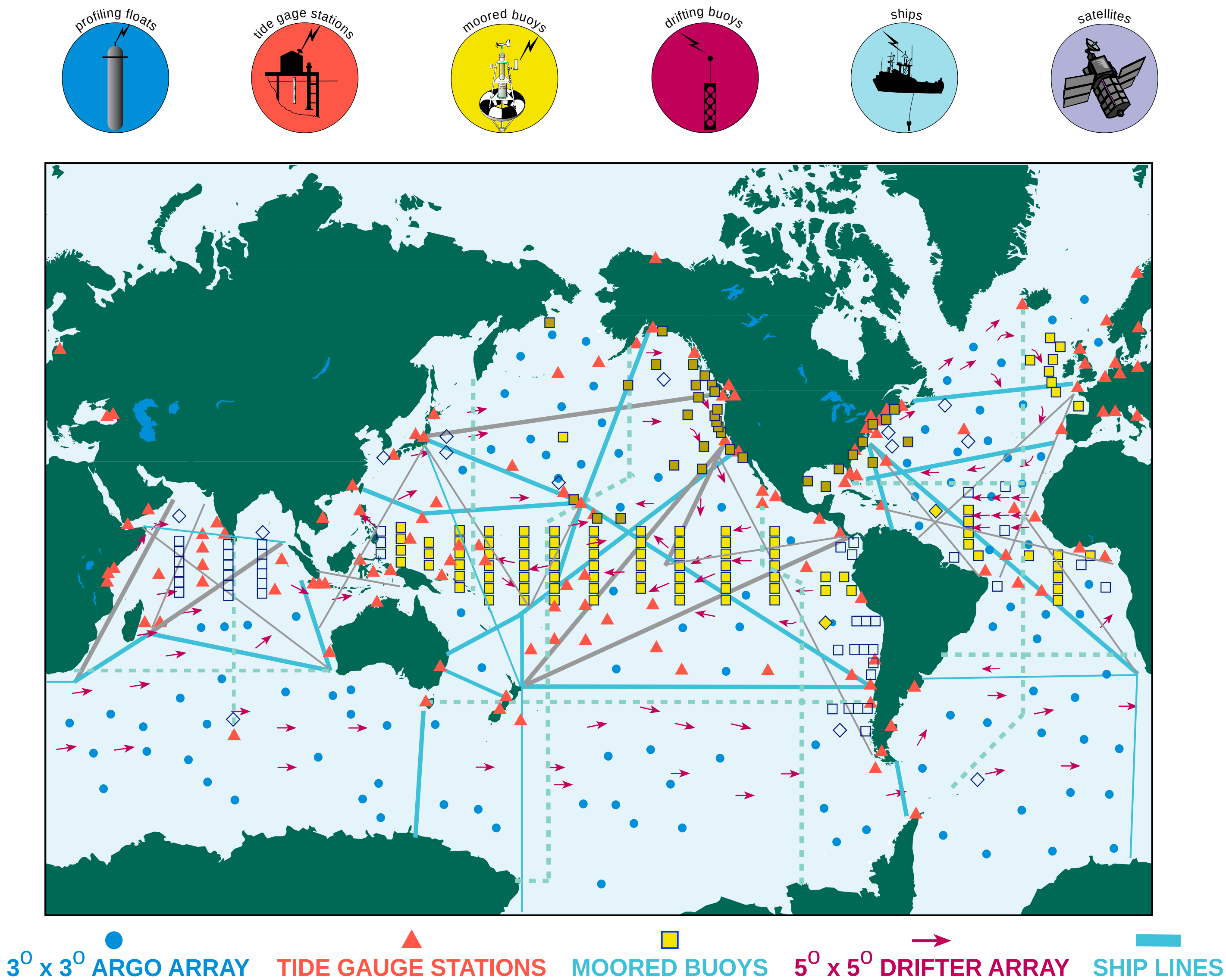
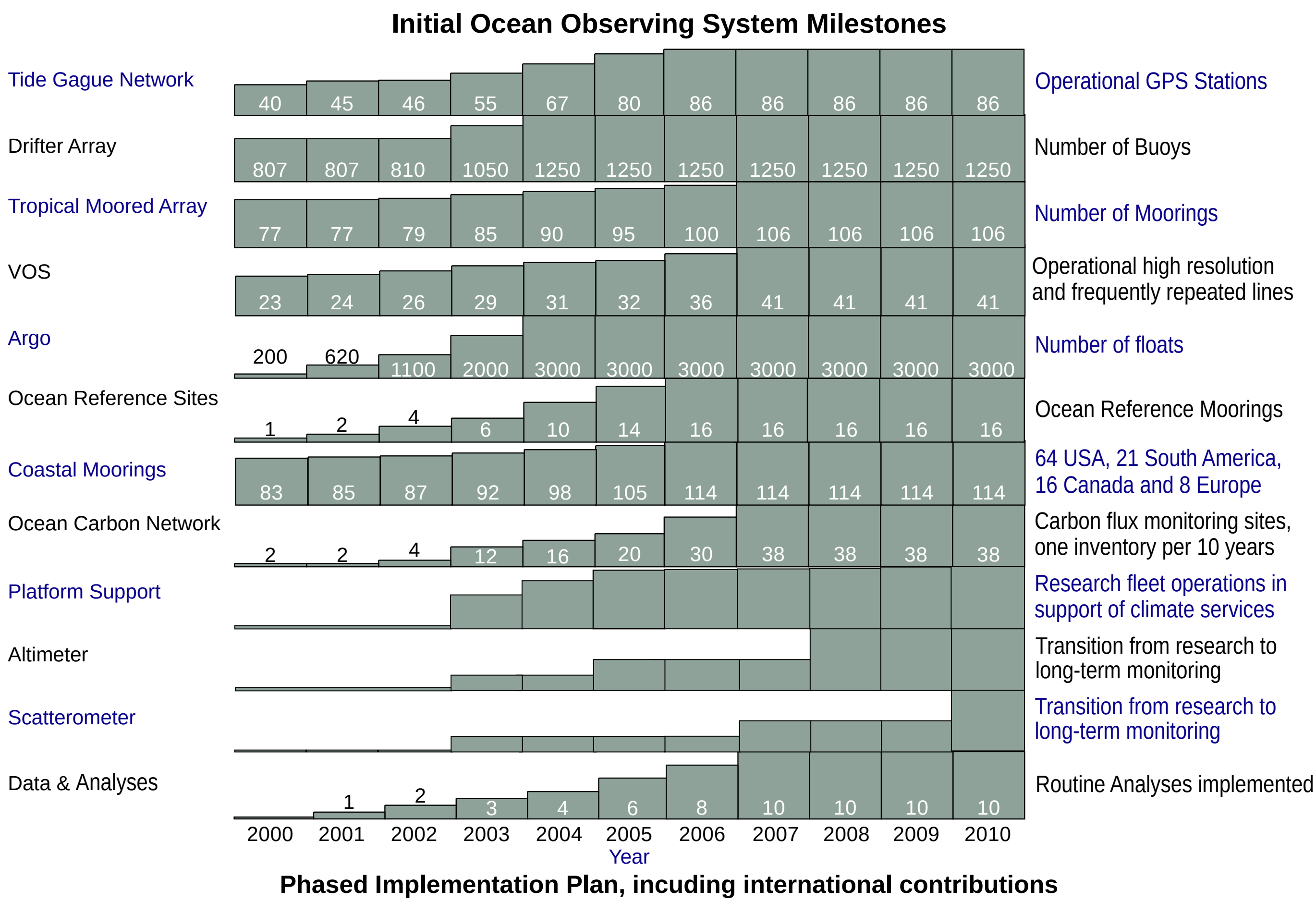


Figure 1



Initial Ocean Observing System Milestones
Tide Gague Network
40 45 46 55 67 80 86 86 86 86 86
Operational GPS Stations
Drifter Array
807 807 810 1050 1250 1250 1250 1250 1250 1250 1250
Number of Buoys
Tropical Moored Array
77 77 79 85 90 95 100 106 106 106 106
Number of Moorings
VOS
23 24 26 29 31 32 36 41 41 41 41
Operational high resolution and frequently repeated lines
Argo
200 620 1100 2000 3000 3000 3000 3000 3000 3000 3000
Number of floats
Ocean Reference Sites
1 2 4 6 10 14 16 16 16 16 16
Ocean Reference Moorings
Coastal Moorings
83 85 87 92 98 105 114 114 114 114 114
64 USA, 21 South America, 16 Canada and 8 Europe
Ocean Carbon Network
2 2 4 12 16 20 30 38 38 38 38
Carbon flux monitoring sites, one inventory per 10 years
Platform Support
Research fleet operations in support of climate services
Altimeter
Transition from research to long-term monitoring
Scatterometer
Transition from research to long-term monitoring
Data & Analyses
1 2 3 4 6 8 10 10 10 10
Routine Analyses implemented
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Year
Phased Implementation Plan, incuding international contributions

Figure 2

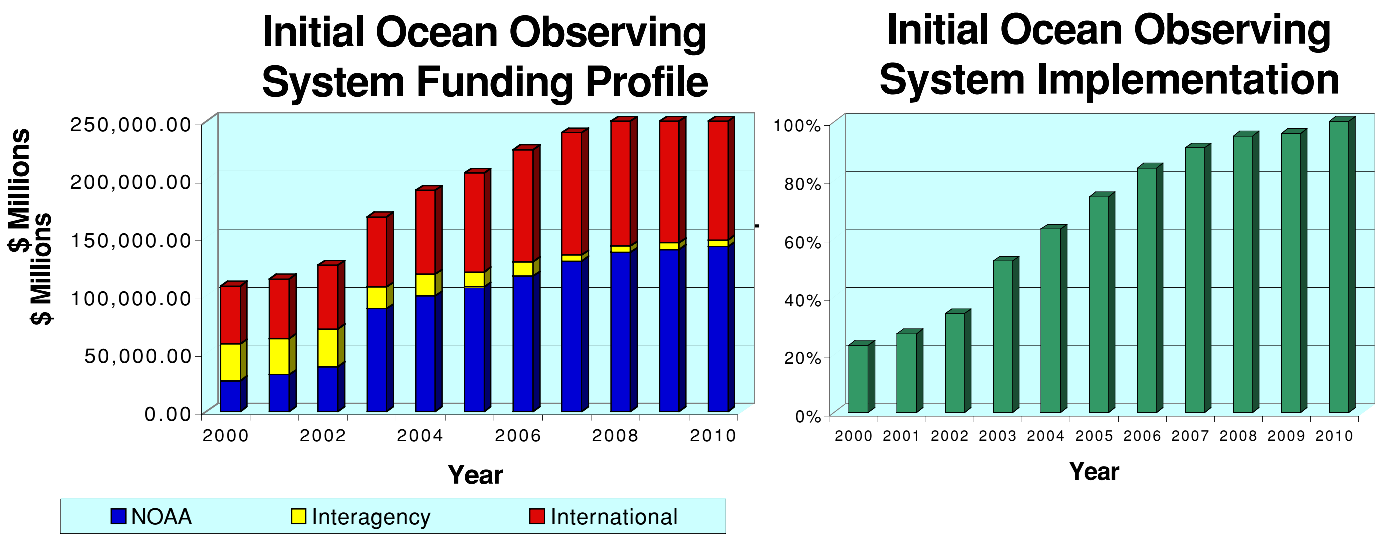

Initial Ocean Observing System Funding Profile
$ Millions
250,000.00
200,000.00
150,000.00
100,000.00
50,000.00
0.00
2000
2002
2004
2006
2008
2010
Year
NOAA
Interagency
International
Initial Ocean Observing System Implementation
100%
80%
60%
40%
20%
0%
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Year

Figure 3

COST ESTIMATE FOR THE OCEAN OBSERVING SYSTEM ($K)												
	FY 00	FY 01	FY 02	**FY 03**	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	Total increase over 10 years
Total International	49680	51230	54830	60200	72150	85460	96400	105100	109700	112900	117500	
Total Interagency	32030	31030	32530	18850	18950	12900	12550	5150	5400	5500	5600	
Total NOAA	26330	31730	38580	**88560**	99420	107110	116610	129760	137220	139700	142080	
Increase over previous yr.		5400	6850	**49980**	10860	7690	9500	13150	7460	2480	2380	115750
Total global program	108040	113990	125940	167610	190520	205470	225560	240010	252320	258100	265180	
Total system complete	23%	27%	34%	**52%**	63%	74%	84%	91%	95%	96%	100%	
DETAIL												
	FY 00	FY 01	FY 02	**FY 03**	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	
Network Totals												
Tide Gauges	610	660	660	**1700**	1930	2100	2260	2410	2480	2570	2630	
Drifter Array	2220	2220	2220	**5260**	6420	7420	8620	8590	8850	9110	9380	
Tropical Moored Array	7050	7020	7020	**10940**	11520	10820	10980	11230	11500	11790	12110	
VOS	1200	1470	1920	**5890**	6740	7560	7670	7800	7900	8020	7920	
Argo	3640	4440	7630	**8780**	8900	8720	8780	8900	9140	9390	9650	
Ocean Reference Stations	590	1290	2210	**4920**	5270	5540	5710	5890	6060	6240	6430	
Coastal Moorings	10000	10000	10000	**12600**	15170	15650	14010	14420	15040	15470	15910	
Platform support	0	0	0	**4600**	5760	6890	7130	7360	7590	7820	8070	
Altimeter	400	2050	2050	**13220**	14340	16460	20550	20790	21050	21300	21570	
Scatterometer	0	0	0	**8500**	8500	8500	9500	18300	22370	22590	22830	
Ocean Carbon	0	200	1120	**3000**	3160	3170	3270	3360	3450	3540	3630	
Data & Analyses	620	2380	3750	**9150**	11710	14280	18130	20710	21790	21860	21950	
Annual Budget	26330	31730	38580	**88560**	99420	107110	116610	129760	137220	139700	142080	
Increase over Previous Year												
Tide gauges		50	0	**1040**	230	170	160	150	70	90	60	
Drifter Array		0	0	**3040**	1160	1000	1200	-30	260	260	270	
Tropical Moored Array		-30	0	**3920**	580	-700	160	250	270	290	320	
VOS		270	450	**3970**	850	820	110	130	100	120	-100	
Argo		800	3190	**1150**	120	-180	60	120	240	250	260	
Ocean Reference Stations		700	920	**2710**	350	270	170	180	170	180	190	
Coast Moorings		0	0	**2600**	2570	480	-1640	410	620	430	440	
Platform Support		0	0	**4600**	1160	1130	240	230	230	230	250	
Altimeter		1650	0	**11170**	1120	2120	4090	240	260	250	270	
Scatterometer		0	0	**8500**	0	0	1000	8800	4070	220	240	
Ocean Carbon		200	920	**1880**	160	10	100	90	90	90	90	
Data & Analyses		1760	1370	**5400**	2560	2570	3850	2580	1080	70	90	
Increase		5400	6850	**49980**	10860	7690	9500	13150	7460	2480	2380	

Table 1