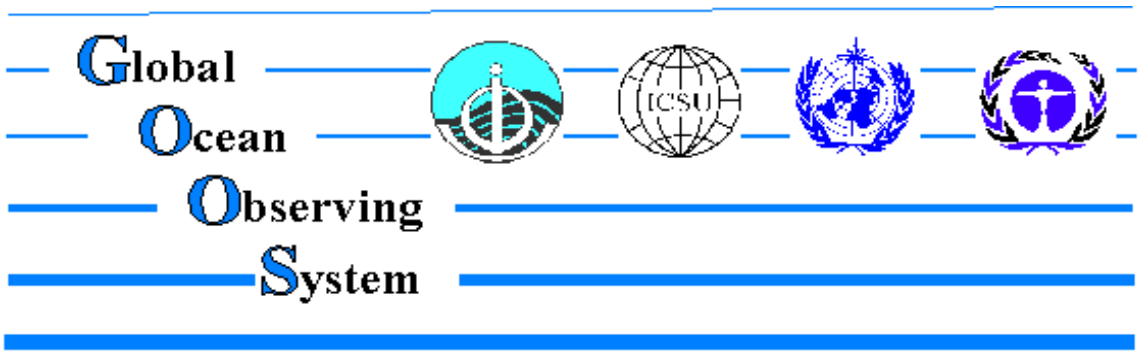

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

Initial Global Ocean Observing System (GOOS) Commitments Meeting

Paris, France
July 5-6, 1999

GOOS Report No. 80

UNESCO

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IOC-WMO-UNEP-ICSU/Impl-III/3
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1. OPENING

At 10:00 hours on Monday July 5th, Dr. Angus McEwan (Chairman) welcomed participants to the Initial GOOS Commitments Meeting.

2. BACKGROUND

He noted that people were attending the meeting in response to IOC Circular Letter No. 1606 (16 April 1999) which invited Member States of IOC and representatives of their marine agencies and other bodies with an interest in GOOS to participate in an Initial GOOS Commitments Meeting, shortly after the 4th meeting of the Intergovernmental Committee on GOOS (I-GOOS) on the 23rd to 25th of June 1999, and concurrently with the 20th General Assembly of the IOC.

This meeting followed recommendations made at I-GOOS-III (Paris, June 1998), and the 19th IOC Assembly (Paris, July 1998), and anticipated endorsement by the IOC Assembly of Resolution XX-7, which called for agreement to the GOOS Principles and plans, and urged Member States to contribute to GOOS implementation within the context of available resources and government policies. The meeting also addressed the call by the Fourth Conference of the Parties to the UN Framework Convention on Climate Change (Buenos Aires, November 1998), urging parties (i) to actively support national oceanographic systems in support of climate observations via GOOS and GCOS, and (ii) to make, to the extent possible, an increase in the number of ocean observations, particularly in remote locations, and to establish and maintain reference stations.

He explained that the Initial GOOS Commitments Meeting was seen as an important early stage in the implementation of GOOS, and one which would enable the present GOOS Initial Observing System to grow by the addition of national components. The GOOS Initial Observing System is described on the GOOS web site at http//ioc.unesco.org/goos.

The meeting was intended to draw together the major organisations and groups world-wide that are already involved in the ocean observing systems and programs to share information on their activities and plans and to declare the extent of their commitment to the implementation of GOOS in the immediate future. It was also intended as a forum and a vehicle for contact of nations and organisations with a potential future interest in GOOS to hear about the components of GOOS observing systems from which they might benefit, and to determine how they might become involved.

He proposed that the meeting should be in three parts:

1. A presentation from the major existing contributors to GOOS of their present commitments and future plans;

2. The holding of a number of 'breakout groups' to allow all participants to define collective interests in and commitments to the major development areas of GOOS;

3. The plenary preparation of a statement or series of statements that will provide timely input to Member States of IOC on the major needs and priorities for GOOS to allow comprehensive consideration of the program during the IOC Assembly.

The alternative to 2 was a discussion in plenary, and this was the option eventually chosen.

He noted that the Meeting was 'non-governmental' in nature and was open to any authorized representative of an organisation or agency (national or international) with an interest in the implementation of GOOS. It was titled the 'Initial' Commitments Meeting in anticipation of there being a number of participants who might not be able to propose commitments at this stage, and the likelihood that other similar meetings will be convened as GOOS develops.

It was intended that contributions might include particular national observing systems, new national commitments to GOOS, or new support for the international co-ordination of GOOS, etc. Contributions might take the form of well established met-ocean buoys, permanent stations of various kinds including sea-level gauges, and repeat hydrographic lines, and in addition might cover any of the 4 modules of GOOS (Climate, Coastal, Living Marine Resources, or Health of the Ocean), provided that they were intended to be consistent with the GOOS Principles published in the GOOS Strategic Plan (IOC/INF-1091), which is available on the GOOS web site (http://ioc.unesco.org/goos/).

The report of the meeting would be published, so as to:

(i) provide information about the continuing growth and development of GOOS;
(ii) highlight certain issues that would need consideration by other bodies such as the GSC and JCOMM, so as to take GOOS development forward smoothly and effectively, and to fill gaps;
(iii) encourage governments and agencies, which had not yet made commitments to do so.

3. MEETING ATTENDANCE AND PRESENTATIONS

Representatives of 20 countries and 5 organisations attended the meeting (Annex 1). In addition two countries (Seychelles and Spain) submitted written statements (Spain was represented at the meeting by the Director of EuroGOOS). Of the 22 countries attending or submitting information, seventeen were involved in presentations at the meeting, as were three of the organisations (EuroGOOS, EUMETSAT and SAHFOS) (Annex 1).

4. SUMMARY OF COMMITMENTS

Annex II gives the objectives of the meeting and instructions for the preparation of presentations. Annex III is a summary of present commitments. Annex IV lists planned or future commitments. The full commitment statements from each country are presented in Annex V.

5. MEETING NOTES

The presentations indicated a variety of forms of GOOS participation, as is evident from the full reports in Annex V. They ranged from a selection of existing national observing activities from which a subset of data would be contributed to GOOS, to detailed specifications of contributions of financial and other support for GOOS activities as well as participation in GOOS-related projects and experiments.

Many of the countries represented have put in place mechanisms for national co-ordination such as GOOS Co-ordinating Committees.

The presentations were followed by a general discussion of issues of interest or concern to countries, in attempting to define their GOOS participation, or to agencies in considering their implementation. The main issues are listed below, starting with 5.1.

5.1 THE DEVELOPMENT OF A NEW PARADIGM – OPERATIONAL OCEANOGRAPHY

It was recognised that GOOS is a response at the global level to the pull that is coming from the user community for operational oceanography. As defined by EuroGOOS (1999) in its brochure *A Profile of Operational Oceanography*, *"Operational Oceanography can be defined as the activity of systematic and long-term routine measurements of the seas and oceans and atmosphere, and their rapid interpretation and dissemination. Operational oceanography proceeds usually, but not always, by the rapid transmission of observational data to data assimilation centres. There, powerful computers use numerical forecasting models to process the data. The outputs from the models are used to generate data products, often through intermediary value-adding organisations. Examples of final products include warnings (of coastal floods, ice and storm damage, harmful algal blooms, and contaminants,*

etc.), electronic charts, optimum routes for ships, prediction of seasonal or annual primary productivity, ocean currents, ocean climate variability etc. The final products and forecasts must be distributed rapidly to industrial users, government agencies, and regulatory authorities."

A distinction can be made into three kinds of operational oceanography products:

nowcasts: provide the most usefully accurate description of the present state of the sea, including living resources;

forecasts: provide continuous forecasts of the future condition of the sea for as far ahead as possible;

hindcasts: assemble long-term data sets which will provide data for description of past states, and time series showing trends and changes.

5.2 THE OPERATIONALISATION OF RESEARCH

Many of the observing activities typical of the open ocean and coastal seas are in fact carried out in a quasi-operational manner by research agencies on research budgets. There is growing recognition that the user community for the data from these activities is far larger than the research community itself, and indeed is sufficiently wide now to justify making the observing systems operational and handing them over to operational agencies to manage. Recent examples of this transition include the Atlas buoys of the Tropical Atmosphere Ocean (TAO) array funded by the USA in the equatorial Pacific, and the ship of opportunity program funded by Australia.

5.3 ADAPTATION OF COASTAL AND REGIONAL OBSERVATIONS TO THE GOOS FRAMEWORK

There is already a wide range of operational observation networks in coastal and regional waters. Together these comprise many thousands of observational stations and activities making a wide range of operational measurements. The problem is to define what subset of them should be in GOOS, recognising issues of sensitivity, commercial value, cluttering of the data system and data sets with information of strictly local interest.

Definition of what is required for GOOS from coastal seas awaits the conclusion of the design process by the Coastal GOOS Panel, which is expected within the next 12 to 18 months.

Several countries and regional groups expressed a willingness to make near-coastal data available on reasonable request and to place operational local and regional data on web sites for interrogation. In this context, EuroGOOS is building a listing of European web sites dealing with real-time data, which at least in part will describe the contribution that European agencies could make to the GOOS Initial Observing System. Several of the components offered by countries attending the Commitments Meeting (Annexes III, IV and V) are registered on this EuroGOOS listing.

It was noted that Regional Sea conventions such as OSPAR, HELCOM and SCAR have already developed multi-national observing systems relevant to all GOOS modules. Interfaces with these, contributing to their assessment requirements, and links to the relevant data centres such as ICES and ICADM, should be developed as implementation proceeds.

5.4 THE NATURAL "SCALES" FOR THE ORGANISATION OF GOOS

The organisation of GOOS by module is sometimes not helpful at national level. The implementation of the Coastal, LMR and HOTO modules should be done in an integrated manner at the appropriate scale. Large Marine Ecosystems define one such scale, for example.

Regional GOOS is a successful approach in the two GOOS's that are extensively developed or implemented (NEAR-GOOS and EuroGOOS), but raises the question of the need for global co-ordination.

Consistent with the endorsement of regional development of GOOS by both GSC-II and I-GOOS IV, some of the representatives indicated their interest in new GOOS regional groupings. Polar regions were mentioned (see below).

5.5 DATA MANAGEMENT AND DATA POLICY

There is an urgent need for defined data policies that can be applied at national level to define commitments. In some cases the policy cannot be defined without knowing the purpose for which the data are to be used.

The meeting considered that any data policy dealing with GOOS should be based on free and unrestricted exchange of oceanographic data, compatible with the spirit and content of WMO Resolution 40 (Cg XII). It was recommended that such a policy be developed by the IOC *ad hoc* group on data policy that was created by the 20th IOC Assembly.

As far as information management is concerned, Information Technology developments and the web are likely to simplify distribution of and access to operational oceanographic data. This still begs the question of what data should be included as part of GOOS and carry the 'GOOS Label'. Potential difficulties were perceived in determining and regulating what is included in GOOS. On the one hand there is a broad spectrum of data available; on the other hand it is not clear how GOOS could handle data subsets with commercial value or national constraints. In addition, the proprietorship of data sets, especially those containing public domain data, is also a concern; will they be in private hands and therefore only available for profit? Questions like these will also apply to space-based remote-sensing data as satellites becomes operationalised. Other areas inviting further work include the automation of quality control.

5.6 CROSS-CUTTING OPERATIONAL AND REAL-TIME SUPPORT

All components and modules of GOOS should be able to provide beneficial results on time scales that might range from hours to decades, and vary according to application. The desirability of being able to respond on time scales appropriate to the application was noted, and there is thus a cross-cutting requirement for improvement of techniques for time-sensitive operational data management and in particular, real-time delivery. XBT SOOP data is transmitted in real-time on the GTS, originally established for meteorology. Increased investment is required to develop skills and procedures for real-time acquisition, processing and distribution of oceanographic data, including the need for automated quality control. There is also a need for improved access to and distribution of associated real-time data products.

Nevertheless, many kinds of data, especially non-physical data, may never be available in (or required in) real time. Definition of acceptable 'timeliness' depends on the application.

There is considerable scope for the use of the Web and web software in 'non-invasive' information flow, including metadata, inventories and compiled data sets and data products.

5.7 THE BALANCED DEVELOPMENT OF GOOS

While most open sea measurements made by the components of the GOOS Initial Observing System are physical, it was clear from many presentations that Member States are making observations potentially contributing to GOOS that would fall into the Living Marine Resources, Health of the Ocean, and Coastal Module areas of GOOS. These measurements include many on (i) water quality and algal blooms (HOTO), (ii) fish stocks, fish larvae (as an

index of variability in spawning and recruitment), plankton, marine mammals including birds (LMR), and (iii) coastal meteorology, coastal waves, sea-level, coastal ecology and coral reefs (C-GOOS). Embracing some of these national observations as part of GOOS makes its balanced development far more evident than might be supposed from examining the open ocean components of the observing system.

5.8 TECHNOLOGY

The ability to incorporate newer and less orthodox technologies is important to some countries. Examples include the use of submarine cables (around Japan) to measure volume transport, acoustic tomography for ocean thermal changes, new techniques for salinity measurement, pop-up and yo-yo buoys and automated packages for remote sensing or chemical analysis using VOS or even aircraft of opportunity. A related matter is to ensure the "portability" of skills and technique.

Technologies for observing physical properties are well developed, leading inevitably to the operational development of physical measurement systems like those in support of forecasting weather, climate, and sea conditions. Nevertheless, technologies for chemical and biological observations are developing fast. It is now feasible to collect dissolved carbon dioxide data operationally underway, along with fluorescence data representing chlorophyll "a", for instance. A biological VOS program will be needed to provide *in situ* validation and calibration for the remote sensing of ocean colour by satellites. Operational biological monitoring has already begun through the Finnish Algaline program in the Baltic, and the Continuous Plankton Recorder Survey in the North Sea and open Atlantic.

Several countries are considering instrumenting moored buoys with additional measuring devices to collect data on nutrients and plankton at key sites, thereby effectively exploiting existing systems.

Important technological developments include improvements to the numerical models used to get the most out of the data obtained by observation.

The continued supply of observations from satellites, many of which may be flying in research mode, is critical. In due course it will be desirable for certain research observations to move to the operational sphere to ensure continuity. A presentation from EUMETSAT showed that an operational system is in place until 2012 through METEOSAT and MSG (METEOSAT Second Generation), and that the EPS METOP satellite is funded from 2003-2015, providing a healthy long life system for the immediately foreseeable future in the European context. This system delivers data within 15 minutes, and SST products on a 30-minute cycle. One key to the future of GOOS is expansion of satellite application facilities, for instance to include ocean, sea ice and climate.

5.9 CAPACITY BUILDING, PARTNERSHIPS, AND THE DEVELOPING COUNTRIES

Inevitably the focus has so far been on developed country actions. The incorporation of responsible and active capacity building elements is seen as essential. Because of the global nature of GOOS, new approaches such as long-term partnerships and public-private funding initiatives for capacity-building should be considered for implementation. One way of entraining partners from less-developed countries may be through the encouragement of activities to expand the margins of existing regional GOOSs such as NEAR-GOOS and EuroGOOS. Similarly, national GOOS committees could incorporate regional capacity building in funding proposals for coastal and EEZ studies. EuroGOOS indicated its willingness to support and assist developing countries in North Africa, the South Atlantic, the Caribbean and Eastern Europe.

Even in developed countries, tight budgets have encouraged the development of innovative approaches to levering funds, usually through the development of partnership funding that in some instances may involve the private sector.

5.10 SOCIO-ECONOMIC BENEFITS

The importance of articulating the socio-economic benefits of GOOS was emphasised. Countries can justify long-term investments in GOOS only when the benefits are evident (as in improved forecasts). Such benefits have been identified only to a small extent, and in more obvious cases such as ENSO prediction. Among the examples cited, Australia noted the strong relation between SST and crop value one season later, a relationship fully justifying investment in the observations needed for seasonal forecasting. Norway's long-term studies show that climate variability has a large effect on fish stocks, through its effect on recruitment, and, further, that the catch of Horse Mackerel in the North Sea can now be forecast from the volume transport of warm North Atlantic Water into the North Sea. Norway also gave examples of the value of ice forecasts to offshore operators of various kinds in Arctic waters. Many countries are providing specialised services like this, tailored to users' requirements.

5.11 ARGO AND GODAE

These experiments are seen as essential to the implementation of global observation systems, not only in the climate context but also in giving real-time capacity for physical modelling in application of the other modules. They are also important in the definition of IGOS and in linking operational satellite remote sensing with surface observation. Several countries detailed their participation in Argo and others sought advice on the means of participation. Regional workshops may be required to spread information about Argo and to train people in use of Argo data.

5.12 POLAR GOOS

Interest was expressed in the possibility of initiating an Arctic GOOS, there being long-standing observation programs that could benefit from the GOOS framework and contribute to the GOOS program. This needs discussion with existing bodies like the Arctic Ocean Sciences Board. In addition to important questions relating to global warming detection for which systematic Arctic and Antarctic monitoring is essential, there is a wide range of important applications such as fisheries, transportation and the oil industry that could draw from an integrated operational system. A coherent approach to observing system design for the Arctic and Southern Oceans is much needed. It was noted that recent modelling work by the Hadley Centre in the UK suggests that the thermohaline circulation in the Labrador Sea may shut down early in the next century, highlighting the importance of Arctic observations.

5.13 CONVENTIONS

GOOS and GCOS have already come to the attention of the Parties to the Framework Convention on Climate Change. It is important that GOOS forms links to the Secretariats for other relevant conventions and Action Plans, like that on Biodiversity, and the Global Plan of Action for the Protection of the Marine Environment from Land Based Sources, for instance. GOOS could provide a central facility for uniting the requirements of the different global and regional conventions and action plans into a common observing system to meet their needs.

5.14 THE ROLE OF JCOMM

The creation of JCOMM was seen as an important development. In addition to its presently defined responsibilities it was seen as useful for:

1. Providing a focus for integrated TEMA activities;
2. Technical review (e.g. to evaluate new measuring systems);
3. The tailored development of data exchange policy and practice;
4. The interfacing of systems between and across modules (especially in the context of Coastal elements);

5. Consideration of formal mechanisms for cementing agreement on contributions to GOOS from Member States.

5.15 PUBLIC COMMUNICATION AND AWARENESS RAISING

The need to raise awareness among the user community, the public and with the various organisations on which voluntary support for GOOS will depend was noted. This implies the ordered development of documents, brochures and web information.

6. RECOMMENDATIONS FOR THE IOC ASSEMBLY

The attendees made the following recommendations to be carried forward to the IOC Assembly on July 7th:

1. Countries should be encouraged by the IOC Assembly to establish mechanisms for the national co-ordination of their contributions to GOOS;

2. Strong support should be given by the IOC Assembly to:

   (a) the proposed inter-sessional working group on data policy;
   (b) the GODAE and Argo projects;
   (c) JCOMM as a key mechanism for GOOS implementation.

3. The summary of commitments (Annexes III and IV of this report) should be attached as an Annex to the report of the IOC Assembly, as a means of demonstrating to all Member States what is meant by GOOS commitments, and to encourage further commitments.

7. NEXT STEPS

It was agreed that the commitments mechanism is a useful way of building the global coverage of GOOS and entraining the interests of nations. Participants also recalled that GOOS is meant to be a scientifically designed system. Therefore in entraining commitments of existing and new systems a process will now need to be developed by the GSC and JCOMM to elaborate and refine the commitments, and to review them in due course to ensure their consistency with the Principles of GOOS. As national plans are articulated the contributions should be evaluated against the Principles and the overall GOOS designs to ensure that the contributions converge with the designs and Principles to the greatest extent possible. Elaboration should include an analytical tabulation of national GOOS commitments, and may in future include catalogues of stations and reporting times.

A second GOOS Commitments Meeting should be considered for inclusion as an integral part of I-GOOS-V.

8. CLOSURE

The meeting was closed at 16:00 hours on July 6th.

ANNEX I

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ANNEX II

MEETING OBJECTIVES AND INSTRUCTIONS TO PARTICIPANTS

1. OBJECTIVES

The overall objective of the meeting was to advance the implementation of the GOOS through the definition of national contributions and the encouragement of further commitments to the GOOS framework. The specific goals were twofold: (i) to obtain statements of national operational or other commitments and potential commitments to GOOS, e.g. in the form of national observing systems, or new national commitments to international observing systems, or new support for international co-ordination of GOOS; (ii) to develop networks and common objectives between agencies in the implementation of GOOS.

2. MEETING ARRANGEMENTS

Ideally each presentation was meant to be on behalf of a country or a named group of agencies or a single agency (as appropriate), and should indicate:

1. A general statement of the views or position on the suitability of the GOOS framework and/or the components of concern to them;

2. Any relevant information on local organisation or co-ordination and how/whether it will interface with the GOOS structure;

3. An indication of if they are prepared/willing/are considering whether to be part of the framework or its component activities and to contribute or make data/products available according to the GOOS Principles and plans;

4. A general overview of the kind of observations/activities that will be available for contribution to GOOS (e.g., Sea level network, coastal stations (and variables), VOS, assimilation, modelling, data centres and so on). A brief show-and-tell of activities was encouraged. Countries were encouraged to mention experimental programs where they can make a significant data contribution, and may become pilots for more permanent systems;

5. Any caveats and provisos on participation;

6. Any obstacles, particularly capacity limitations, territorial hurdles or objections to the GOOS as presently formulated;

7. Statements of where the GOOS/intergovernmental process can facilitate participation.

For this meeting a great deal of detail was not considered necessary to convey views and commitments needed to guide the way forward and to advise the IOC Assembly and its governmental representatives on the attitudes and needs of the potential GOOS contributors.

The presentations should be regarded as source information for discussion or breakout sessions to map future actions and from which the Statement of the Meeting can be drafted for conveying to the IOC Assembly in time for consideration of the Agreements Resolution.

ANNEX III

SUMMARY OF PRESENT COMMITMENTS

These commitments are extracted from those more fully expressed in the national and agency contributions in Annex V, modified by comments received during post-meeting circulation of the report. In assessing them the reader should note that many countries are not yet represented, and that even for those countries who did make contributions those contributions may not represent all agencies in those countries.

1. GLOBAL OCEAN (CLIMATE MODULE)

- Operational El Niño observing and forecasting [Australia, USA]
- TRITON moored buoy network in the equatorial Pacific [Japan]
- GOOS and ENSO related research in the equatorial Pacific and Kuroshio regions [Japan]
- PIRATA (extension of TAO to the Atlantic) [Brazil, France, USA]
- Maintain existing arrays monitoring change in ocean structure [Australia]
- Operationalise SOOP network, and/or maintain involvement in SOOP and/or VOS lines [Australia, France, Germany, Japan, Netherlands, Russia, USA]
- Establish COOE (Co-operative Ocean Observing Experiment) [Australia]
- Antarctic observation program (XBTs, buoys, tide-gauges sea ice measurements) [Australia]
- National Buoy Programs of drifting and moored buoys, usually including continued contribution to DBCP [Brazil, Canada, France, India, Japan, Netherlands, UK, USA]
- Time series stations (i) off Canary Islands) [Spain and EC partners], (ii) at the site of OWS P in the Pacific, and the site of OWS BRAVO in the Atlantic [Canada], and (iii) at the HOTS (Hawaii) and BATS (Bermuda) sites [USA]
- Repeat hydrographic sections (i) on Line P in the Pacific, and on the Labrador section in the Atlantic [Canada]; (ii) of waters around Scotland [UK]; (iii) of the Ireland to Greenland section [Netherlands]; (iv) across the North Atlantic to monitor heat transport by N. Atlantic Current [Germany]; and (v) along 137E and 165E in the western North Pacific [Japan]
- GODAE [Australia, USA]; implementing MERCATOR project as contribution to GODAE [France]; and involvement in the European component ESODAE [Netherlands]
- Remote-sensing satellites, for topography/altimetry (TOPEX/POSEIDON) [France, USA], ocean colour [India, Japan, USA], sea surface temperature [India, USA] and winds [Japan, USA]
- Acoustic Thermometry of Ocean Climate (research and experimental project in co-operation with USA [Russia]
- Monitoring ocean-atmosphere interaction (research project) [Russia]
- Global data on SST distribution (nowcast) [Russia]

2. LIVING MARINE RESOURCES MODULE

- Continuous Plankton Recorder profiling [Australia, SAHFOS]
- Observations of whales, seals seabirds, fish stocks in the Southern Ocean [Australia]
- Great Barrier Reef Monitoring program [Australia], and other coral reef monitoring [Japan, USA]
- Algaline operational ecosystem monitoring of the Baltic [Finland], and biological monitoring of the Baltic [Germany]
- Long-term zooplankton recording at Heligoland [Germany], and monitoring phytoplankton and algal blooms by the Nansen Center [Norway]
- Composition of sublittoral macrobenthos [Germany], and mapping seabed communities near-shore [UK], and marine biological environments near-shore [Japan]
- Biological monitoring of fish stocks [Germany, Japan, UK, USA]
- Marine ecosystem monitoring [Seychelles]

3. HEALTH OF THE OCEAN MODULE

- Monitoring pelagic plastics [Australia]
- National water quality network [France, Japan]
- Coastal Ocean Monitoring and Prediction System (COMAPS) [India]
- Marine pollution monitoring of coastal waters [Japan]
- North Sea and Baltic monitoring programs (contribution to OSPAR and HELCOM) [Germany], assessment of the state of the Baltic [Russia] and Baltic monitoring in Baltic-GOOS [Sweden] (note that other Baltic countries are also involved in HELCOM but did not make commitments at this time)
- Monitoring oil slicks [Japan, Norway]
- Harmful algal bloom monitoring [Spain]
- Black Sea GOOS Project [Russia and partners in IOC Black Sea regional committee]
- Monitoring quality of marine environment near sites of industrial discharge [UK]
- Mussel Watch [Japan, USA]

4. COASTAL MODULE

- Sea level monitoring network, usually in addition to maintaining tide gauge stations of GLOSS, and useful in addition for example for calibration of TOPEX/POSEIDON data, [Brazil, Canada, Chile, France, India, Japan, Russia, Spain, USA]
- Meteorological coastal stations [Brazil], and meteorological buoy network [Spain]
- Oceanographic and marine meteorological surveys [Japan]
- Atlantic, Pacific and Arctic Ocean monitoring programs [Canada]

- Coastal buoys and fixed stations [USA]

- Specific regional coastal studies (CALCOFI, Gulf of Maine, Chesapeake Bay program, S. Florida ecosystem restoration) [USA]

- North Sea and Baltic (MARNET) automated monitoring network (10 stations) including Met data [Germany], and network of fixed observation stations in the North Sea [Netherlands]

- Federal states agencies coastal monitoring programs [Germany]

- Ocean wave information network [Japan]

- PORTS program [USA]

- Wave buoy network, wave remote measuring, and wave forecasting program [Russia, Spain]

- Storm surge forecasts [Germany, Russia, Spain, UK]

- Tsunami forecast [Japan, USA]

5. ALL ASPECTS OF COASTAL SEAS

- Operational oceanographic services (e.g. including sea state and ice conditions) [Germany]

- Marine meteorological observation service at sea [Germany]

- Environmental observing system of Institute of Marine Research (IMR)[Norway]

- Observations and services of the Marine Forecasting Centre of Norwegian Meteorological Institute (DNMI) [Norway]

- Nansen Centre products and services including: ocean fronts, jets and winds, ice information, and ocean modelling and data assimilation [Norway]

- Operational hydro-meteorological services in Arctic and Antarctic [Russia]

- Marine meteorological analyses and forecasts including ice conditions [Russia]

- Coastal monitoring program assess vulnerability of low-lying areas to flooding and sea-level rise [Japan, UK]

- Ship routing services [UK]

6. DATA AND INFORMATION MANAGEMENT

- Expand quantity and types of data and information exchanged through the Internet in NEAR-GOOS [China, Japan, Russia]

- Operate NEAR-GOOS real-time database at JMA, and NEAR-GOOS delayed mode database at JODC [Japan]

- Data management through NODCs [France, Germany, Japan, Russia], or Designated National Agencies [Seychelles]

- Data Management (e.g. of GTSPP, drifting buoys, waves and others) through Marine Environmental Data Service (MEDS) [Canada]

- Special Ocean Data Centre for IGOSS in Meteo-France, Toulouse [France]
- IGOSS specialised ocean centre for the Pacific [Japan]
- GOOS Data Centre [USA]
- Global Collecting Centre for marine meteorological data [Germany]
- Global Precipitation Climatology Centre [Germany]
- Marine information products and services [India]
- Sea-ice information system [Japan, Russia]

7. COORDINATION, POLICY AND INFRASTRUCTURE

- National Ocean Policy [Australia]
- National Ocean Conference [USA]
- Developed and Published Policy Proposal for Improved Monitoring of System Earth [Netherlands]
- Developed and published outline US Plan for Integrated Sustained Ocean Observing System [USA]
- Establish GODAE Bureau in Melbourne [Australia]
- Support for IOC GOOS Office in Perth [Australia]
- Establish Joint Australian Facility for Ocean Observing Systems [Australia]
- Partnership for Observing the Global Oceans (POGO) formed [USA, UK, France, Germany, Japan]
- National GOOS Co-ordinating mechanism [Brazil, India, Norway, Russia, UK, USA] (others may have such committees but were not present at the meeting)
- National workshops and Newsletter on NEAR-GOOS data, to better serve users [China]
- Development of Space Oceanology [Russia]

8. FINANCIAL

- $45,000/yr for 3 years for C-GOOS, LOICZ links and capacity building [Netherlands]
- $10,000/tr for GLOSS [UK]
- SIDA/SAREC funding for specified GOOS activities [Sweden]

ANNEX IV

SUMMARY OF PLANNED OR POSSIBLE FUTURE COMMITMENTS

1. GLOBAL OCEAN (CLIMATE MODULE)

- Implement an Australian Ocean Observing System (AOOS) [Australia]
- Augment buoy programs in S.W. Atlantic [Brazil] and S.E. Pacific [Chile]
- Increase deployment of drifting buoys [Brazil]
- Automate several Met stations on coast and on St. Peter and St. Paul islands for real-time data transmission [Brazil]
- Increase use of SOOP for subsurface data [Brazil]
- Seasonal sampling using time series stations and hydrographic sections [Canada]
- Substantial contribution of floats to Argo [Australia, Canada, France, Germany, Japan, USA]
- Trans-ocean sections off E and W coasts every 8 years to assess transports of heat, freshwater and carbon [Canada]
- Observations of transport on Labrador shelf and through Canadian Archipelago [Canada]
- Launch of new remote sensing satellites, for altimetry (JASON) [France], ocean colour [China], and environment (NPOESS) [USA]
- Satellite gravity and salinity [USA]
- TRITON moored buoy program in the equatorial Indian Ocean [Japan]
- Start operational ENSO forecasting [Japan]
- Design and implement CORIOLIS Project for observing the Atlantic, to contribute to (i) PIRATA, (ii) continuation of SOOP lines in the Atlantic, (iii) maintenance of involvement of DBCP, (iv) Argo, and (v) EMMA pop-up profilers [France]
- Develop ocean monitoring system for climate change forecasting [Russia]
- Network of Global Eulerian Observatories (time series stations) [USA]
- CLIVAR basin-scale studies [Netherlands, USA]

2. LIVING MARINE RESOURCES MODULE

- Enhance ecological monitoring of Great Barrier Reef and N.W. Shelf, and other areas [Australia]
- Analyse harmful algal blooms [Brazil]

3. HEALTH OF THE OCEAN MODULE

- Monitor (i) contaminant discharges and ocean health indicators in S.W. Atlantic, (ii) solids in suspension on continental shelf, (iii) accumulation of garbage along beaches, and (iv) chemical pollutants in the atmosphere over the Atlantic [Brazil]

- MAREL moored automated water quality system [France]

- Coastal Index Sites; Long-term ecological research sites [USA]

4. COASTAL MODULE

- Automate several tide gauges [Brazil], and enhance the tide gauge network [Canada], including adding 2 new tide gauges in Arctic and Labrador for climate purposes [Canada]

- Sea ice off Labrador, in Canadian Arctic and in St. Lawrence [Canada]

- Participation in Black Sea GOOS, and development of regional pilot projects for the Baltic and Arctic in conjunction with EuroGOOS [Russia]

- Instrumentation of ferries as part of the EuroGOOS program [Netherlands]

5. ALL ASPECTS OF COASTAL SEAS

- Further development of operational marine meteorological and oceanographic services [China, Russia]

- Further develop space-based observing systems, acoustical and buoy technologies for ocean monitoring [Russia]

- A network of coastal laboratories and programs (LabNet) [USA]

- Instrumentation of yachts as SOOPs by the International Sea-Keepers' Society [USA]

6. DATA AND INFORMATION MANAGEMENT

- Develop data assimilation models [Australia]

- Improve national data co-ordination [Australia]

- Incorporate industry-generated data into monitoring statistics [Australia]

- Create GOOS-focussed data management system [Brazil]

- Prepare oceanographic climatic atlases, charts and guides for shipping [Russia]

- Improve system for oceanographic data/information exchange [Russia]

7. CO-ORDINATION, POLICY AND INFRASTRUCTURE

- Upgrade research/survey vessels [Australia]

- Refurbish existing and establish new coastal and island research stations in southern temperate and north-east tropical waters [Australia]

- World Water Forum and Ministerial Conference, The Hague, 2000 [Netherlands]

8. FINANCIAL

- Starting in 2000, $19,000 (=£12,000)/ yr. for 3 yrs for biological aspects [UK]

- Anticipate improved contribution to Capacity Building for GOOS [Netherlands]

ANNEX V

WRITTEN NATIONAL OR ORGANISATIONAL STATEMENTS PRESENTED AT THE MEETING

V.1 AUSTRALIA

An Australian Contribution to GOOS

1. BACKGROUND

From the early beginning of GOOS, Australia has volunteered advice and assistance in the development of plans and to the better definition of the goals and principles that GOOS should follow. This commitment to the concept of GOOS, and now to its implementation, remains strong, as evidenced by the prominent roles taken by Australian scientists within the GOOS program and by the devotion of considerable resources to ocean and marine observations. Australia likens the commitment to GOOS to that for meteorology where Australia has been a strong supporter of, and contributor to, the World Weather Watch. Australia regards the development of a GOOS as the appropriate framework for developing an integrated, global, international co-operative system for gathering and disseminating information on the oceans, a system that is in place for the good and benefit of all.

The oceans surrounding Australia are of vital importance to the health and wealth of the nation. As most of the population lives within easy reach of the ocean, the importance of the coastal seas and estuaries for recreation and tourism is obvious to most Australians. The area of Australia's Exclusive Economic Zone (EEZ), within which Australia has the right to explore and exploit living and non-living resources, is forty percent larger that the Australian mainland. The Australian Marine Jurisdiction (AMJ), which includes this area, also includes that part of the Legal Continental Shelf lying beyond the 200 nautical mile EEZ outer boundary – a total area of around 16 million square kilometres. This is only the surface area – the volume of waters in the AMJ encompasses an enormous variety of conditions in waters that can be up to 5,000 metres deep.

Australia has an interest in all aspects of the GOOS. The extent of the EEZ and AMJ mean there is a strong emphasis on the coastal marine environment, including its living resource and for the effective management of the marine environment and the development, support and management of marine industry. Australia is also subject to significant climate variations, variations that are linked with the occurrence of droughts and floods through much of the continent.

Australia was among the first to initiate a national framework in support of GOOS and its sister system, the Global Climate Observing System (GCOS). A Joint Working Group was formed for GCOS and GOOS, sponsored by those national entities corresponding to the intergovernmental sponsors of GOOS. An Expert-Sub Group for (Australian) GOOS was formed in 1993 and it began the process of defining an Australian effort. An Australian plan for GCOS was published in 1998, including significant oceanographic elements.

However, in recent times these activities have been overtaken by a decision to draft a national oceans Policy (released in December 1998; Http://www.environment.gov.au/marine/frameset/oceans/fs_ocean_main.html) and a national Marine Science and Technology Plan (due for release in June 1999).

The Oceans Policy states:

"Knowledge of the natural variability of the oceans is essential for many marine activities, from ship routing to recreation. The most well known of these is the El Niño-Southern Oscillation effect. Such knowledge is also essential to our understanding of the major global changes which influence our environment, economy, cultural and social fabric. The development, implementation and review of Regional Marine Plans will also require a sound understanding of ocean systems.

The Government will promote and support the Australian, Pacific and Global Oceans Observing Systems as mechanisms to develop the oceans-related data capture and exchange necessary for improving prediction and management.

The Government will support the establishment and operation of a Regional Office of the Intergovernmental Oceanographic Commission in Perth, Western Australia."

There is also a stated commitment to develop an improved national marine data management system. A National Oceans Ministerial Board has been created for ultimate oversight. It will be supported by a National Oceans Advisory Group and National Oceans Office.

The Marine Science and Technology Plan has now completed an extensive review process and contains strong references to an Australian Ocean Observing System (AOOS) and the GOOS. It is expected that three program areas will be defined:

- Understanding the marine environment,
- Using and caring for the marine environment, and
- Infrastructure for understanding and utilising the marine environment.

A likely objective within the third Program is to implement systematic, coordinated and long-term marine observational programs through an AOOS. The draft text for this objective states:

"The marine environment is highly variable on all space and time scales and is difficult to observe. The observations required extend from local, through regional to global in scale, and require coordination with regional and international partners. The time-scales of natural variations can extend over days, months and years at the ocean surface and in coastal/estuarine locations, through to decades and even centuries in the deeper ocean. Because of this variability, there is a requirement for spatially comprehensive chemical, geological and biological data that are obtained on a regular, continuing basis: the oceanographic equivalent of operational meteorological data.

With modern super-computers and data distribution networks there is now the real prospect that useful numerical model simulations and 'operational' tools of ocean circulation and ecosystem dynamics for all kinds of maritime purposes can be run in near 'real-time'. The requirement is for integrated systems including observations, data transmission, the assimilation of data in numerical models, and the distribution of resultant products, akin to meteorological analyses)."

It has been proposed that a renewed effort be mounted within Australia, based on the strong support, in concept at least, for an AOOS and on the growing momentum for GOOS and several associated initiatives and the increased international focus provided through the UN Framework Convention on Climate Change and its Conference of the Parties at its most recent meeting.

The following is largely based on the draft text for the Marine Science and Technology Plan but there is a strong expectation that this will remain for the announced Plan. This Plan suggests the new "home" for the AOOS will be within this Program and framework. AOOS activities will continue to be coordinated with other GOOS activities through the existing Joint Working Group that will remain the formal connection to the GOOS structure.

2. SPECIFIC AREAS OF INTEREST AND PRIORITIES

As a basis for informed management there is a critical need to understand the nature and extent of marine biodiversity, the impacts of introduced marine organisms, and the oceanic and biological processes that sustain the various levels of biodiversity, at a regional level. Australia attaches great importance to the systematic gathering of data in support of such understanding, particularly in its coastal waters. Two foci are emerging; the southern temperate (coastal) waters that encompass the South Western and South Eastern Regions,

which contain some of our more important fisheries, tourism values, and petroleum resources and are also affected by mainland coastal development and aggregations of populations in large urban centres; and a northern tropical program, focussing on an understanding of the region's marine resources and ecosystems in support of commercial fishing, aquaculture, the oil and gas industry, etc. A key strategy in pursuit of these objectives is to undertake strategic and coordinated surveys and inventories of key marine habitats (coastal, benthic, pelagic and deepwater). At least some of these activities will relate to the AOOS and to the Living Marine Resources and Health of the Oceans modules of GOOS.

Development and environmental pressures are contributing to change and variability in the marine environment. The development and application of effective monitoring and assessment procedures and sustainable management practices is one objective in the pursuit of the knowledge base required to support marine industry development and the ecologically and economically sustainable use and management of the Australian Marine Jurisdiction, particularly in the coastal zone.

Australia has responsibility for, and commitment to, the provision of a range of marine services including sea state warnings, extreme weather warnings and other information in support of recreational, commercial and other activities at sea and various industries who are sensitive to changes in operating conditions. These services are dependent on a range of data including marine meteorological observations and sea state observations.

Many aspects of Australian society are susceptible to change in climate, from time scales ranging from seasons to the interannual and longer. Northern Australia has strong dependencies on the seasonal monsoons. Interannual variations that are among the largest in the world are sensitive to ocean conditions in the Pacific (El Nino), Indian and Southern Oceans. Australia is also likely to be sensitive to longer period excursions in climate and, potentially, to climate change. Australia has a strong record of research in these areas and places strong emphasis on the development of appropriate observational systems.

3. INITIATIVES RELEVANT TO GOOS

Several initiatives have been proposed or have been supported in the Oceans Policy, subject to satisfactory funding arrangements. Without exception, these have been proposed in a manner that is consistent with GOOS Principles and best practice. In many cases they represent potentially significant support for the implementation of GOOS Plans. While national imperatives and needs provided the most significant drivers, the support of an AOOS and thus of GOOS can be taken as indicative of an intention to work within the GOOS framework and its guidelines. In particular, Australia has been a strong supporter of the free and open exchange of data, particularly with respect to national meteorological requirements, and there is an expectation that this policy will be extended to AOOS data to the extent possible.

Three initiatives are likely to draw strong support within the Marine Science and Technology Plan.

Upgrade the Research Vessels Franklin *and* Southern Surveyor

The research vessels *Franklin* and *Southern Surveyor* are a critical element of the national ocean observation effort, providing one of the very few means to observe the continental shelf and deep water regions surrounding Australia. These vessels are critical elements of our National Facilities and it has been proposed that both should be refurbished, and their equipment upgraded to extend their range of oceanographic observation capabilities. It has further been proposed that the available time at sea should be extended by around 200 days per year.

There are several other measures that have been proposed that would significantly improve the national facilities, including for routine ocean observations (for example, the refurbishment of existing, and establishment of new, coastal and island research stations in southern temperate and northern and northeast tropical waters).

Implement an Australian Ocean Observing System (AOOS)

An immediate priority concerning marine scientific data involves the implementation of systematic, coordinated and long-term marine observational programs designed to assist Australia's participation in the Global Ocean Observing System. For effective management, the establishment of a system of long-term monitoring programs is regarded as a matter of priority. The existing long-term observing programs in Australia should be reviewed, and the most appropriate supported in the context of a comprehensive Australian Ocean Observing System (AOOS). A comprehensive AOOS should identify gaps, and provide support to fill those gaps. The AOOS should develop or adopt novel technologies to provide automated, comprehensive and cost-effective observations of key physical, chemical, geological and biological variables. A component of the AOOS should support the international effort to improve observations in the South Pacific, Indian and Southern Oceans. Further detail is given below.

Better coordinate the management of marine data

Well organised, accessible baseline information on biological, physical, geological and chemical characteristics of the marine environment is fundamental for effective management of the marine environment and the development, support and management of marine industry. However, large numbers of nationally important marine data sets are dispersed among Federal and State government agencies, research organisations and universities, and are stored in a variety of ways, not all amenable to easy collation. Linking these data sets can yield new information and insights into the form and structure of the oceans. An immediate priority therefore relates to better marine data management including coordination of national efforts to collect, preserve and make available basic data on Australia's marine environment.

4. AN OVERVIEW OF KEY STRATEGIES FOR THE AOOS

It is critical that baseline information is not collected on an *ad hoc* basis. Data must be collected in directed programs, defined by issues and intended outcomes. Careful scientific consideration and planning is necessary to ensure that data obtained through any one program is rigorous, comparable among programs, and accessible. Adequate resourcing of any data program is essential; consistency of resourcing over long time scales is important; and high priority should be placed on this by Governments, data collecting agencies and processors.

For effective management, the establishment of a system of long-term monitoring programs is regarded as a matter of priority for Australia. The existing long-term observing programs in Australia are to be reviewed, and the most appropriate supported in the context of a comprehensive AOOS. A comprehensive AOOS should identify gaps, and provide support to fill those gaps. The AOOS will develop or adopt novel technologies to provide automated, comprehensive and cost-effective observations of key physical, chemical, geological and biological variables. A component of the AOOS should support the international effort to improve observations in the South Pacific, Indian and Southern Oceans. Satellite data are becoming increasingly important for both regional and global observational programs and Australia needs to ensure continued access to this data stream.

Australia believes the observational streams should be integrated through data assimilation models being developed in programs such as the Global Ocean Data Assimilation Experiment (GODAE) and for Australia's EEZ region.

Several specific strategies have been proposed and are likely to be part of the formal release of Australia's Marine Science and Technology Plan (and thus constitute the detailed response to the Oceans Policy). These include:

- Implement a comprehensive Australian Ocean Observational System, in the international context of GOOS and related international initiatives (e.g., the Global Climate Observing

System – GCOS), that incorporates existing observations and arrays and provides resources to fill the gaps;

- Develop temperature and salinity profile monitoring programs (including as part of the global Argo float program), and programs to monitor water quality and pelagic and benthic communities, in areas that are subject to heavy use or that have special significance for environmental protection, conservation, scientific purposes, or for prediction of ocean conditions and Australian climate;

- Develop a total system of monitoring the sea state around the Australian coastline;

- Develop standard operating protocols and benchmarks for measurements in the marine environment, including those for long-term marine biological diversity monitoring programs;

- Maintain the existing arrays that monitor variability and change in the ocean structure (e.g., the National Baseline Sea-level Monitoring Network and the Volunteer Observing Ship Program), and expand ocean structure monitoring to include chemical and biological parameters;

- Enhance programs of long-term ecological monitoring of the Great Barrier Reef and the NW Shelf, and renew or commence long term monitoring programs in other strategic locations such as the South Eastern, South Western and Northern Marine Domains;

- Develop data assimilation models that produce operational products available to a wide range of users, and that link national programs with international programs, to maximise returns;

- Incorporate industry-generated data into long term monitoring statistics, for example fisheries catch statistics and offshore oil and gas survey and environmental assessment information;

- Link long-term monitoring programs, both present and future, to a national marine data coordination strategy (see Section 3);

- Link long term monitoring program data to state-of-the-environment reporting at the appropriate scale, through scientifically credible environmental indicators;

- Develop long term monitoring programs to acquire data sets for use in planning and designing marine structures;

- Review and recommend appropriate long-term monitoring locations and equipment for the measurement of ecological, chemical, physical oceanographic and water quality variables, including for example international standard Deep Ocean Time Series stations;

- Review the historical data held by government and industry (where available) and implement a program of collation, standardisation and quality assessment to enable its use and integration with new data and to extend time series;

- Contribute Australian technology to major international observing projects such as GODAE/Argo, where there are benefits; and

- Develop a mechanism for program integration and coordination between agencies and across disciplines.

Several steps have already been taken toward these goals. These include the establishment of a Joint Australian Facility for Ocean Observing Systems; the transitioning of the research-supported ship-of-opportunity XBT network to operational support; the support of significant monitoring programs in the vicinity of the Great Barrier Reef; the establishment of a

multi-disciplinary "pilot" project for GOOS called the Cooperative Ocean Observing Experiment (COOE); the operational implementation of analysis and prediction systems in support of for marine forecasts and climate (e.g., El Niño) predictions; the hosting of the International GODAE Office; the support of a regional IOC Office in Perth in support of GOOS, including substantial WA state support; significant research and observational support for climate change studies; and significant efforts in support of state-of-the-environment reporting.

5. PRINCIPAL ORGANISATIONS

Many different organisations and institutions are likely to be involved in the establishment of an AOOS. These include the Australian Institute of Marine Science; the Bureau of Meteorology; the Centre for Research on Ecological Impacts of Coastal Cities; CSIRO; Fisheries WA; James Cook University; NSW Fisheries; Primary Industries and Resources SA; Queensland Department of Primary Industries; South Australian Museum; TAFI (University of Tasmania); University of Melbourne; University of Queensland.

Three organisations, namely the Australian Institute of Marine Science, the Bureau of Meteorology and CSIRO Marine Research have made a commitment to the establishment of an AOOS and are engaged in preliminary discussions to better define priorities and schedules for implementation.

As with all such endeavors, resources are going to be limited and, at this time, there has not been any substantial increment to existing long-term commitments. However, with the development of new Policy and Science and Technology plans, there is renewed optimism that such commitments will be made.

The existence of a robust and substantial international GOOS effort will be extremely important for obtaining national commitments. If it can be argued that the "whole" is not just potentially but actually returning benefits far in excess of national commitments, then modest increments in key areas is that much more probable.

6. AUSTRALIAN GOOS-RELATED ACTIVITIES IN ANTARCTICA

Based on presentation by Harvey Marchant and Ian Allison, Australian Antarctic Division.

6.1 CLIMATE MODULE:

* buoys in the sea-ice zone (Meteorology, ice drift)
* buoys with temperature and salinity sensor strings
* sea-ice thickness (1980-1997 from ship observations)
* sea-ice thickness measurements at coastal stations
* sea ice thickness measurements from upward looking sonar
* sea-ice ridging (aircraft laser altimetry, image analysis of shadows in digital aerial photography, SAR)

Shipboard measurements:-

* temperature
* salinity
* fluorescence (chlorophyll a)
* XBT (temperature/depth profiles)
* sea-ice thickness (electromagnetic and laser under development)

Remote sensing measurements:-

* sea-ice extent (Radarsat SAR, passive microwave)
* ice-shelf dynamics

6.2 COASTAL MODULE:

* tide gauges (Mawson, Casey, and Davis stations, Macquarie and Heard Islands)

6.3 HEALTH OF THE OCEANS MODULE:

* pelagic plastics

6.4 LIVING MARINE RESOURCES MODULE:

Shipboard measurements:-

* continuous plankton recorder (CPR)
* hydroacoustics
* whale sightings (IWC methodology)
* seabird monitoring
* fish stock assessments

Land-based measurements:-

* Adelie and Emperor penguin monitoring programs
* Weddell and Elephant seal monitoring

V.2 BRAZIL

1. INTRODUCTION

The Global Ocean Observing System (GOOS) was established by the Intergovernmental Oceanographic Commission (IOC), a segment of the United Nations Educational, Scientific and Cultural Organisation (UNESCO), in cooperation with the World Meteorological Organisation (WMO), and the United Nations Environment Program (UNEP), in view of the provisions contained in the 1982 United Nations Convention on the Law of the Sea (UNCLOS), and of the items of Agenda 21, Chapter 17 (Oceans Protection). Agenda 21 recognises the need to develop a global observing system aimed at providing a better understanding and a more accurate monitoring of ocean alterations and their effects.

Thus the principal justification for setting up GOOS has been the need of the IOC Member States for assistance concerning the development of capability to predict oceanographic phenomena and processes that actually exert direct influence upon the climate and the preservation, conservation and sustainable use of the oceans.

With its ratification of UNCLOS and adherence to Agenda 21, Brazil considered the extent of the maritime area of national interest over which sustainable development ought to be secured, and decided to stand for its participation in the GOOS Program, thereupon creating the GOOS/Brazil Pilot Program, under the aegis of the Inter-Ministerial Commission on Resources of the Sea (CIRM), for execution by the Directorate of Hydrography and Navigation (DHN).

The motivation for the establishment of the GOOS/Brazil Pilot Program lies in the necessity for the implementation, systematization and operational worthiness of data collection, analysis and transmission within the entire oceanic region of national interest, and the generation of products that have social-economic impact on the country.

Certain regions of Brazil, like the Northeast, are subject to the influence of phenomena such as the “El Niño Southern Oscillation”, which strongly affect activities connected to agriculture. The understanding of ENSO, and the perception of the processes that determine the influence of the oceans on decennial and seasonal climate changes, can be converted to social use through the products generated as a result of the execution of GOOS in Brazil. Other products may be relevant to transportation, commercial trade, and safety of navigation, for example, such as the output of numerical models for the prediction of swells, which may help to cut costs by means of indicating more acceptable shipping routes etc. The improvement of marine weather forecasts in the Atlantic Ocean, the monitoring of coastal erosion, as well as environmental control, in a most generic manner, will certainly profit from the execution of the GOOS/Brazil Pilot program.

2. BRAZILIAN PROPOSAL FOR GOOS ACTIVITIES

2.1 PRESENT COMMITMENTS

- Sea level monitoring (many tide gauges, nine of them within the GLOSS Program, are administered by the DHN);
- Extension of the TAO array into the tropical Atlantic Ocean (Pilot Research Moored Array in the Tropical Atlantic – PIRATA);
- National Buoy Program (PNBOIA): drifting and moored buoys in the South Western Atlantic Ocean (24 drifting buoys already deployed);
- Meteorological coastal stations.

2.2 FUTURE PLANS

- National Buoy Program (PNBOIA): two moored meteorological buoys in the South Western Atlantic Ocean;
- Increase the deployment of drifting buoys;
- Instrument the Saint Peter and Paul Archipelago with automated meteorological station;
- Automate several existing meteorological platforms so they can transmit data in real-time;
- Increase the use of ships of opportunity to collect surface marine data;
- Automate several tide gauges;
- Monitor contaminant discharges and ocean health indicators in the South Western Atlantic Ocean;
- Monitor solids in suspension along the Brazilian continental shelf;
- Monitor the accumulation of garbage along Brazilian beaches;
- Use fixed platforms to monitor chemical pollutants in the atmosphere over the Atlantic Ocean;
- Analyze harmful algal blooms;
- Create a GOOS-focused data and information management system infrastructure based on a distributed network of regional, national and international world databases.

V.3 CANADA

1. INTRODUCTION

Canada continues its support of GOOS as the principal international mechanism for obtaining long-term systematic observations of the marine environment, both regionally and globally, to meet a broad range of user requirements. In the past this support has primarily involved Canadian participation in the planning of GOOS through its panels, working groups, and I-GOOS, as well as through Canada's support of the infrastructure that is being used to implement GOOS. In the future, Canada will contribute more directly to GOOS through the designation of parts of its long-term monitoring effort as contributions to GOOS and do so in a manner that is consistent with the GOOS Principles. The extent of Canadian involvement in GOOS awaits further development of the detailed design of the GOOS observing system for all the GOOS modules, especially those which require observations in the Canadian EEZ and which are less developed than the climate module. Another obvious constraint will be the ability to commit long-term funding to GOOS in times of government cutbacks and assessment of priorities. However, given Canadian concerns regarding climate change and the marine environment, the opportunity exists to make a substantial contribution to GOOS.

2. CANADIAN GOOS ORGANISATION AND PLANNING

Within Canada, the responsibility for the planning and implementation of ocean observing systems rests primarily with the Department of Fisheries and Oceans (DFO). Collaborations are established with other departments and agencies to include those variables for which the responsibility falls outside DFO. Within this framework, ocean monitoring programs have been developed for the ocean off both the Atlantic and Pacific coasts and to a lesser extent for the Arctic. They have been designed to meet various Canadian requirements for marine environmental information and have elements that span C-GOOS, LMR and HOTO interests.

More recently, in the post-Kyoto spirit, Canada has been planning its potential contributions to GCOS, including the ocean, terrestrial and atmospheric elements. In addition, requirements have been defined for the augmentation of the sparse GCOS global network to provide the enhanced climate observing system needed to meet Canadian national interests. Canada’s additional ocean climate observations, beyond those required for GCOS, will be taken on the continental shelves and in the oceans directly off Canada's coasts. Long-term government support for Canadian climate observations for GCOS, and its Canadian augmentation, is being sought. Some elements are however presently being routinely carried out as part of existing monitoring and research programs.

3. POTENTIAL CANADIAN CONTRIBUTIONS TO GOOS

Serious consideration has been given to what Canada could contribute to the GOOS/GCOS common climate module given adequate resources. First priority has been given to (1) five geocentrically positioned tide gauges (2 on the east coast, of which one would be a new gauge on the coast of Labrador, 2 on the west coast and one in the Arctic, also a new gauge); (2) continuation of the research-based time series on Line P and at the site of OWS P in the Pacific, at the site of OWS Bravo, and on an annual section across the Labrador Sea; and (3) a substantial contribution of profiling floats to the Argo program that might eventually total about 5 percent of the global array. Canada would consider providing profiling floats for the global array in regions other than off Canada's coasts should the contributions of other nations provide regional coverage in areas of particular Canadian interest. Slightly lower priority has been given to carrying out one transocean section off both the east and west coasts every eight years for the assessment of the inventories and transports of heat, fresh water and carbon.

This contribution to the global GOOS/GCOS physical ocean observing system would be augmented by (1) seasonal sampling using hydrographic sections and time series stations of the water properties on Canada's continental shelves and adjacent seas including the Arctic (roughly 12 sections and 8 time series stations on the east coast including the Gulf of

St Lawrence, 9 sections on the west coast and a moored climate station and annual hydrographic survey in the Beaufort Sea region of the Arctic Ocean; (2) an enhanced tide gauge network, some of which would be geocentrically positioned (roughly 6 gauges on the east coast, 4 gauges on the west coast and one in the Arctic, all of which would be in addition to those contributing to the climate module); (3) direct observation of the transport on the Labrador shelf and through the Canadian Archipelago, (4) observations of sea-ice concentrations, extent and velocity both off the coast of Labrador, in the Gulf of St. Lawrence and in the Canadian Arctic. In the case of limited resources priority will be given to maintaining parts of the hydrographic and tide gauge networks as well as to observations of sea ice. How much of the above observational array would contribute to GOOS depends on the final design of the global C-GOOS observing system. In any event, Canada would be willing to contribute the observations it is taking to GOOS as the evolving GOOS plans indicate is appropriate. Data presently being obtained is already being archived in the international data management system.

Potential Canadian contributions to the HOTO and LMR modules are less clear, partly as the result of the less advanced state of both GOOS and Canadian planning in these areas. However, under the 'Canada Oceans Act', Canada has placed considerable emphasis in developing coastal zone management strategies and designating various ecologically sensitive areas as 'Marine Protected Areas'. Furthermore, Canada does have operational programs in these areas, especially as they relate to fisheries, fish habitat and overall marine environmental quality. In an effort to evaluate the effectiveness of current monitoring programs in meeting Canada's ecosystem objectives for integrated oceans management and conservation a Canadian workshop will be held in the fall of 1999. Performance measures by which observational tools used to monitor the ocean ecosystem can be assessed, will also be discussed. It is expected that in addition to addressing Canadian issues this will aid Canada's input to the design of the LMR module and better indicate how Canada could most effectively contribute to this aspect of GOOS.

Canada will also continue its contributions to the infrastructure supporting the implementation of GOOS. As in the past, Canada through the Marine Environmental Data Service, as a member of the IODE system, will continue to be the RNODC for both the present suite of data as well as those resulting from new technologies. GTSPP, drifting buoys, thermo-salinographs and ARGO are a few examples of such data sets. In addition, Canada will continue collaborating with other countries to develop data management policies and guidelines by providing expertise to the various implementation panels of GOOS modules.

4. SUMMARY

In general, Canada supports the development of GOOS as a planned and co-ordinated observing system to provide data and products of known quality to the global community to meet user needs. While the boundary between what Canada contributes to GOOS and what should remain in the Canadian context is still to be determined, Canada will support international efforts to make GOOS as comprehensive as possible within the framework of the GOOS Principles of design and involvement. Canada views climate change and marine environmental matters in general as issues requiring an international approach and will support the contribution that GOOS can make to the extent possible taking into account the available resources.

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V.4 CHINA

Statement by China at the GOOS Commitment Meeting

In the light of the GOOS requirements, particularly the GOOS Action Plan, China is making appropriate adjustment to its ocean observing system. Presently, China has established an ocean observing system composed of ocean observing stations, data buoys, research vessels, radar, voluntary observing ships, as well as airborne and satellite remote sensing equipment. For the purpose of strengthening the ocean observing system, China has incorporated the ocean observing system in to the 'China Ocean Agenda 21' and its Action Plan.

1. CONTRIBUTION TO GOOS

China is the first country who initiated the NEAR-GOOS together with other countries of the region. With the joint efforts of China, Japan, Korea and Russia, the NEAR-GOOS was put into operation in 1996. China is now contributing data from 14 ocean observing stations and one ocean data buoy to the Internet. Accordingly, China has established the real-time and delayed-mode data centres in Beijing and Tianjin respectively,.

At the 3rd session of the NEAR-GOOS Coordinating Committee in 1998, Dr.Yu Zhouwen, Director of China's National Marine Environmental Forecasting Centre, was elected Chairman. To push forward the development of NEAR-GOOS, China plans to take the following actions:

1. to expand the quantity and types of data to be put on the Internet;
2. to convene workshops for national users of NEAR-GOOS data, to better serve the users;
3. to organize international workshops on monitoring technologies and data exchange within the context of GOOS; and
4. to publish a NEAR-GOOS newsletter and introduce the updated development of GOOS to Chinese readers.

2. FUTURE PLANS OF ACTION

As a response to the requirements of the GOOS Commitments Meeting, the following are some of China's plans of action in the near future:

1. China will further develop its ocean observing system based on its social economic needs in accordance with the requirements of GOOS and provide continuous and greater contributions to GOOS;

2. China has incorporated the already established ocean observing system in the 'China Ocean Agenda 21' and its Action Plan. Efforts will be made to incorporate this system into GOOS.

3. China will make its utmost efforts to provide data collected from sea-level, ocean observing stations, ocean data buoys, as well as from the ocean colour satellite to be launched in 2001, to GOOS;

4. China will further adjust the criteria and standards related to ocean observing systems to cater to the requirements of GOOS, and jointly with other countries, turn GOOS into a global system of ocean data collection and transmission.

V.5 FINLAND

GOOS-related activities in Finland include:

* ice surveillance (extension, thickness, ridges) from satellites and field observations;
* wave surveillance (buoy stations)
* sea level surveillance (coastal automatic stations)
* surveillance of the distribution of surface temperature and algae by Alg@line (see details below, from the Alg@line brochure).

Alg@line

The Finnish Institute of Marine research is carrying out operational monitoring of the Baltic Sea environment through a joint effort of research institutes and shipping companies through Alg@line. Alg@line is a forerunner in the field of monitoring research. Alg@line monitors the fluctuations in the Baltic Sea ecosystem in real-time using several approaches (algaline@fimr.fi).

It combines studies onboard research vessels with high frequency automated sampling on several merchant ships, CPR transects, satellite imagery, buoy recordings and traditional sampling in coastal waters. Ecosystem models are under development.

Without the high frequency observations with the ship-of-opportunity technique, the rapid fluctuations in the Baltic Sea ecosystem could not be monitored. Alg@line is the only research project which utilizes the ship-of-opportunity technique in the monitoring of the state of the environment on this scale. Alg@line has analysers and sample collectors on five ships.

Unattended recordings and water sampling, including CPR tows, on board Silja Lines and Transfennica's ships are the basis of the system. Satellite imagery (NOAA/AVHRR) gives basin wide information on the distribution of surface accumulations of blue-green algae and the temperature of surface waters. Aerial surveys by frontier guard pilots record visible blooms. Pilots collect water samples for species determination. Research Vessels perform specific case studies. Buoys record fluctuations in environmental parameters with high temporal resolution at fixed positions. Analyses of water samples give information on phyto- and zooplankton species composition and nutrient composition. Toxicity of blooms is also determined. Ecosystem models will be used to predict short and long-term changes for various parameters.

Alg@line provides on line information. The information based on the unattended recordings on the ships is available without delay on a specific web site, Alg@line Database. Alg@line Database provides information in Finnish, Swedish, Estonian and English. The web address is http://meri.fimr.fi

The main products are:

* weekly/daily reports on the state of the marine environment
* annual assessments on the state of the marine environment
* plankton species reports
* long term and seasonal variation in plankton, nutrients, oxygen, etc.
* taxonomic phytoplankton sheets
* phytoplankton image gallery

Alg@line is cooperation:

Alg@line is the leading monitoring program in the Baltic Sea. Cooperation between several research institutes and shipping companies has made this possible. The Finnish Institute of Marine Research coordinates the project. In Finland, the Uusimaa, West-Finland and South-East Finland Regional Environment Centres as well as the Environment Centre of the Helsinki City are the partners. The Estonian Marine Institute operates Alg@line on the southern coast of the Gulf of Finland. Cooperation with the Swedish Meteorological and

Hydrological Institute is beginning this year. Alg@line is actively participating in the work of HELCOM, ICES and EuroGOOS.

Cooperation with the shipping companies:

The support provided by the shipping companies, especially by Silja Line and Transfennica, has promoted the development of the project. The white research fleet of Silja Line is the elemental component of the project. Funds donated by Silja Line, in ready money of 1 million FIM in 1998, made it possible to develop the Alg@line Information Database and most if its content.

The Continuous Plankton recorder, a method to collect zooplankton with the ship of opportunity method, is now in operational use in the Baltic Sea. This mission is supported by Transfennica.

V.6 FRANCE

French proposal for GOOS contributions

1. INTRODUCTION

In France, discussion between relevant organisations has led to a consensus on the actions that may contribute to the development of the Global Ocean Observing System (GOOS). The objective is to make GOOS a truly operational program, responding to clearly expressed needs, built from existing systems and including several pilot projects. The following proposal has been approved in principle between different ministries, but the final definition of the program and the exact involvement of people, material and finance will depend largely on the conclusions of the Initial GOOS Commitments Meeting. The details of the diverse projects covered can be found in the report of France to I-GOOS-IV.

2. THE ACTORS

In France, eight organisations are active in one way or another in the development and implementation of GOOS:

- CERFACS (Centre Européen de Recherche et de Formation Avancée en Calcul Scientifiques);
- CNES (Centre National d'Etude Spatiales);
- CNRS (Centre National de la Recherche Scientifique) au travers de l'INSU (Institut National des Sciences de l'Univers);
- IFREMER (Institut Français de Recherches pour l'Exploitation de la Mer);
- IFRTP (Institut Français de Recherche et de Technologie Polaire);
- IRD (Institut de Recherche pour le Développement, ex ORSTOM);
- Météo-France;
- SHOM (Service Hydrographique et Océanographique de la Marine).

The actions forseen in support of GOOS by these organisations are steered by the Committee that unites their Directors (CDO). In addition, the French national committee for the IOC, which can be considered perhaps the national focal point for GOOS, ensures liaison with the IOC and its subsidiary bodies.

3. THE ACTIONS

1. To maintain and develop the existing contributions to the GOOS Initial Observing System (GOOS-IOS):

This action is designed to ensure the continuity of operational contributions to existing international programs, notably the VOS (voluntary observing ships) the GTS (global telecommunications system), SOOP (XBT line, data centres), DBCP (actions in the Atlantic and Indian Oceans), and GLOSS (the ROSAME network in particular), not forgetting corresponding actions taking place under the aegis of IODE (including GTSPP and the MEDAR and MEDATLAS projects).

2. Participation in main pilot projects of GOOS, notably GODAE, and contribution to CLIVAR in the Atlantic Ocean:

- Ocean modeling from the point of view of the definition and implementation of an operational oceanography centre, through the Mercator program.

- Continuation of the spatial observation effort, through the national contribution to the Jason I and Jason II programs.

- Development of an integrated observing system for the Atlantic Ocean, through the Coriolis project, associating surface observations (DBCP, VOS, SOOP), the contribution from the PIRATA network of buoys, the deployment of profiling (PROVOR) floats within the Argo project in the Atlantic, and the development of systems like EMMA (eulerian, expendable, pop-up, profiling probe).

3. Development of knowledge and means of observation of the coastal environment, with notably:

- Putting in place a national program of research for the coastal environment (PNEC – Program de Recherche National pour l'Environnement Côtier).

- Continued operational exploitation of the national network of observation (RNO) of water quality, as well as continuation of the networks specialising in microbiology and phytoplankton (REMI and REPHY).

- Development and demonstration of the potential of integrated environmental surveillance systems, through the MAREL project.

4. Promoting international cooperation, especially at the regional level:

All these actions only make sense in the framework of wider international cooperation, through groups like EuroGOOS and its Atlantic project, through MedGOOS and its Mediterranean Forecasting Project, through EUMETNET and its EUCOS project, through the action groups of the DBCP, and so on. As well as contributing to these, France will make a contribution to the implementation and functioning of JCOMM.

4. COMMENTS

In the first instance, the French contribution to GOOS will concentrate on actions under the following bullet points:

- The Climate module, considered as the best defined, through actions forseen under 1 and 2 above;

- The Coastal module, through actions under 3 above;

- The Services module, which cross-cuts and unites the other modules in a federal way, with the projects outlined above all tending towards the creation by 2003-2005 of operational centres producing services for a wide variety of users.

The material and financial means to achieve this end are in the course of evaluation, and will depend naturally on the cooperation that can be effected, and the regulatory framework that will exist at the international level. For that reason France regards it as very important that the following two points are given high priority:

- To define a coherent policy for access to data in the framework of the GOOS program, much as WMO has achieved with its Resolution 40. France is ready to contribute to this effort.

- The necessary development of norms and standards for exchange and access to GOOS data and products, which in turn requires a close association with the relevant program of the IOC, namely IODE, and of the WMO, namely the CBS.

V.7 GERMANY

[Note that a full description of the German contribution to GOOS has been published as 'BSH, 1999, German Program Contribution to the Global Ocean Observing System (GOOS)' Berichte des Bundesamtes für Seeschiffahrt und Hydrographie No. 19, Hamburg und Rostock, 74 pp.]

Germany attaches high priority to the implementation of a global operational oceanography. Both the world scientific community and the maritime services need operational oceanographic data for a timely and reliable description and forecast of oceanic conditions. This purpose is not achievable by sporadic research projects only. It requires the long-term monitoring of the oceans and adjacent seas.

From the very beginning of planning the Global Ocean Observing System (GOOS) Germany actively participated in its design and implementation. Germany is represented in the Intergovernmental Committee for GOOS, and several German scientists work in GOOS related panels.

Germany has established its initial contribution to GOOS which will be provided on a voluntary basis. The complete German GOOS program is described in BSH, 1999. The Report consists of three chapters: the first describes the scientific background in detail; the second compiles in a tabular form the operational contributions; whereas the third chapter describes in a tabular form pre-operational R&D projects which may be of relevance to GOOS.

The main program elements which contribute to all five GOOS modules comprise the following components:

Climate

- Ship-of-opportunity program (SOOP)
- Transatlantic oceanographic section every third year to monitor the long-term fluctuations in the heat transport by the North Atlantic Current

Living Marine Resources

- Long-term zooplankton recording at Heligoland
- Investigation and biological monitoring of fish stocks (identical with the German contribution to the ICES program)
- Investigation into the composition of sublittoral macrozoobenthos (sampling at 27 stations in the Ems, Jade, Weser, Elbe and Eider)
- Young fish surveys to monitor size and structure of fish stocks in the North Sea
- Biological monitoring in the Baltic Sea (identical with the German contribution to HELCOM)

Health of the Ocean

- Monitoring program of the North Sea and Baltic Sea (identical with Germany's national monitoring program and its contribution to OSPAR and HELCOM)

Coastal Zone

- Monitoring network of 10 automatic recording oceanographic stations in the North Sea and Baltic Sea (MARNET), including meteorological observations
- Several coastal programs conducted by federal states agencies
- Some of the above mentioned components also contribute to the Coastal Zone Module of GOOS.

Services

- Operational oceanographic services, such as water level and storm surge forecast, ice prediction and forecast of state of the sea
- National Oceanographic Data Centre (DOD)
- Marine meteorological observation service at sea
- Global Collecting Centre (GCC - collection, archiving and distribution of marine meteorological data sets)
- Global Precipitation Climatology Centre (GPCC)

There are several research projects as part of the German CLIVAR participation which also contribute to GOOS.

There are 12 German institutions which constitute the German contribution for the initial phase of GOOS. These are the:

Bundesamt für Seeschiffahrt und Hydrographie (Federal Maritime and Hydrographic Agency - BSH)
Bundesforschungsanstalt für Fischerei (Federal Research Institute for Fisheries - BFA-Fi)
Bundesanstalt für Gewässerkunde (Federal Institute of Hydrology - BfG)
Deutscher Wetterdienst (German Weather Service - DWD)
Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Centre - DLR)
Forschungs- und Technologiezentrum (Research and Technology Centre - FTZ)
GKSS Forschungszentrum (GKSS Research Centre)
Institut für Ostseeforschung an der Universität Rostock (Institute of Baltic Research at the University of Rostock - IOW)
Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer (State Agency for the Nationalpark Waddensea Schleswig-Holstein)
Landesamt für Natur und Umwelt Schleswig-Holstein (State Agency for Nature and Environment Schleswig-Holstein - LANU S.-H.)
Landesamt für Umwelt und Natur Mecklenburg-Vorpommern (State Agency for Environment and Nature Mecklenburg-Vorpommern - LAUN)
Technische Universität Hamburg-Harburg (Technical University Hamburg-Harburg - TUHH)

V.8 INDIA

Extracted from the Indian GOOS brochure

1. GLOBAL SYSTEM

GOOS is internationally co-ordinated by IOC, WMO, UNEP and ICSU to observe the ocean continuously and systematically on a global scale. It is being built from the efforts and contributions of national and international organisations including private industry and non-governmental organisations.

India has committed itself to participate in GOOS. Department of Ocean Development, Govt. of India has been holding workshops and meeting since 1996 to spread awareness and importance of GOOS among the scientific community in India. A national GOOS committee is set up to formulate and to integrate the existing GOOS related programs and plan their implementation.

India would operate on the following GOOS defined modules:

- Climate monitoring, assessment and prediction
- Monitoring and assessment of living marine resources
- Monitoring of coastal environment and its changes
- Assessment and prediction of the health of the ocean
- Marine meteorological and operational oceanographic services.

2. GENERAL INTRODUCTION

This is a time when the environment, climate and resource depletion are all becoming global concerns. During the earth's 4.4 billion year history, climate has varied and changed on a wide range of time scales. These changes have caused extreme hardships and at times catastrophes for evolving ecosystems and more recently to human populations. Humans have yet to experience the full range of variability that the planet's natural system impose.

The oceans form a vital part of the climate system through their large heat storage capacity. This capacity acts as a giant flywheel to moderate the climate. Considering therefore the global nature of the ocean - atmosphere coupling, a complete understanding of climate behaviour in one hemisphere is not possible without an understanding of that in the other. Co-ordinated efforts are therefore inevitable. GOOS is a major step in this direction.

3. ONGOING NATIONAL EFFORTS

India's agro-based economy is largely dependent upon the monsoon and its variability. Since oceans play a key role in monsoon formation, many institutions have been working on diverse aspects relating to this. Following are the major ongoing observational programs.

3.1 COASTAL OCEAN MONITORING AND PREDICTION SYSTEM

Coastal Ocean Monitoring and Prediction System (COMAPS) is an ongoing observation program along the coastal waters of India and involves participation of 11 organisations since 1992. The program, structured to build up a data base of long term time-series measurements on the level of pollutants and their fluxes, is aimed to develop predictive models.

3.2 SEA LEVEL MONITORING AND MODELLING

Sea level monitoring and modelling (SELMAM) is another co-ordinated effort with impetus from the IOC-UNEP-WMO pilot activity on sea - level changes and associated coastal impacts, being implemented since 1993. About 11 coastal tide gauge stations have

been established for accurate tide measurements to develop a numerical model and simulate ocean circulation in the northern Indian Ocean.

Training workshop on sea-level data analysis was held during 1995 at the instance of the IOC. This was aimed at enhancing expertise in the Indian Ocean Rim countries.

3.3 DRIFTING BUOY PROGRAM

3.3.1 Moored data buoy array in coastal and open ocean water

A set of 12 buoys deployed are equipped with Global Positioning System and satellite transceiver. Standard measurements are:

- Wave height and direction
- Wind speed and direction
- Air pressure
- Air temperature
- Current speed and direction
- Water temperature and profile
- Conductivity
- Dissolved oxygen
- Radioactivity
- Hydrocarbons
- Chlorophyll a and nutrients

The data buoy program is supporting a cyclone prediction and the Indian Climate Research Program (ICRP).

Drifting buoy program for the north Indian Ocean was launched in 1991. It formed a significant component of the sea-truth collection effort for the National Ocean Remote Sensing Program aimed at developing marine science information system (MARSIS) for the Indian seas.

Over 30 drifters have been deployed and data on the surface meteorology and oceanographic aspects acquired through ARGOS.

3.4 SATELLITE COASTAL & OCEANOGRAPHIC RESEARCH

The Satellite Coastal Oceanographic Research (SATCORE) is designed to develop capability to generate algorithms for various met-ocean parameters from available satellite sensors.

3.4.1 OceanSat IRS - P4

The recently launched dedicated Indian satellite for ocean remote sensing (OceanSat IRS - P4) carries two payloads: Ocean colour monitor (OCM) and a Multi-frequency Scanning Microwave Radiometer (MSMR). These payloads will be extensively used for ocean productivity studies, weather forecasting and air-sea exchange observations.

3.5 EQUATORIAL CURRENT METER ARRAY

To address the deep-sea current variability in the equatorial Indian Ocean and understand the heat content variability a number of current meter moorings will be deployed in 3-4 pre-selected sites along the equator.

3.6 ANTARCTIC EXPEDITIONS

India has been actively undertaking expeditions to Antarctica since 1981. The continent holds details of climatic and atmospheric records of hundreds of years and

regulates global climate more so of the southern hemisphere. It also forms a very good platform to monitor the process of ozone depletion.

4. JOINT INTERNATIONAL VENTURES – GOOS SUPPLEMENTARY

India as been actively participating in various bilateral and international programs such as JGOFS, TOGA, WOCE, CLIVAR & INDOEX.

Several activities have been integrated under National Ocean Information System (NOIS) which consists of 13 marine data centres on:

Oceanography • Remote Sensing • Pollution • Algal Resources and Marine Chemicals • Offshore Fisheries • Coastal Zone • Bathymetry • Tidal Level • Meteorology • Marine Geophysics • Coastal Marine Living Resources • Bioactive Substances • Marine Geology

Necessary interfaces are provided by the IOC-recognised Responsible National Oceanographic Data Centre (RNODC) at NIO.

4.1 TROPICAL OCEAN GLOBAL ATMOSPHERE

The TOGA program in India is a spin-off of Monsoon, continuing since 1990, with repetitive probing of the temperature profiles of the sea using ships of opportunity in the Indian Ocean. Repeat XBT/X-CTD sections will continue until 2001 in north Indian Ocean, and for another decade in the Bay of Bengal.

4.2 JOINT GLOBAL OCEAN FLUX STUDY

India's participation in the Joint Global Ocean Flux Study (JGOFS) aimed at understanding the flux of carbon dioxide and nitrogen in the Arabian Sea and to develop regional models that can predict short/long-term climatic changes. An important addition to this International Geosphere-Biosphere Program (IGBP) is the component to study Land-Ocean Interaction through Coastal Zone (LOICZ). Similar JGOFS studies are now planned for the Bay of Bengal - the Bay of Bengal Process Studies (BOBPS).

4.3 WORLD OCEAN CIRCULATION EXPERIMENT

India also contributed to the World Ocean Circulation Experiment (WOCE), through a repeat hydrography section in the Bay of Bengal and eastern Central Indian Ocean.

4.4 INDIAN OCEAN EXPERIMENT (INDOEX)

The circulation in the equatorial Indian Ocean is very unique as compared to the other two oceans because of the seasonally reversing monsoon winds over the Indian sub-continent. The Indoex would improve our understanding of this and enable validation of general circulation model and chemistry of transport of aerosols, clouds and climate interactions.

5. NATIONAL INFORMATION SERVICE

5.1 OBSERVATIONS

5.2 COMMUNICATIONS

- Real-time radio links
- On-line
- Internet
- Imageries
- Facsimilies
- CD-ROM
- Reports

5.3 PROCESSING

6. INFORMATION PRODUCTS & SERVICES

- Bi-weekly Potential Fishing Zone Maps
- Daily SST, ocean colour and microwave radiometric maps
- Data Inventories
- Operational Models
- Cyclone warning
- A suite of coastal and offshore information from data buoys
- Daily drifting buoys trajectories
- Storm surge evaluations
- Coastal zone advisories
- Demarcation of safe swimming zones
- Shipping advisories
- Mangrove and coastal wetland development

7. GOOS INDIA

- encompasses all national GOOS activities.
- provides the pathway to links with regional and global GOOS initiatives.
- continually augments present GOOS contributing systems.
- establishes permanent reference stations on offshore islands - on Lakshadweep (Arabian Sea) and on Andaman-Nicobar (Bay of Bengal).
- to catalyse through a blue triangle of oceanographic concern linking the Indian sub-continent, Africa and Australasia.
- integrates networking information systems such as Gulf of Kachchh, Gulf of Khambhat, estuaries and creeks.

V.9 JAPAN

Japanese National Report for GOOS (1999)

1. INTRODUCTION

Japan has established repeated hydrographic sections in the adjacent seas and in the western North Pacific Ocean since 1960's and will utilise the recent world impetus to maintain and enhance the existing ocean observing system. For the development of the GOOS, Japan recognises the importance of establishing an interactive scheme among basic researches, technology development and operational programs.

In Japan, several Ministries and Governmental Agencies are taking part in GOOS and conducting related activities. The Ministry of Education, Science and Culture, and the Science and Technology Agency have been supporting basic studies and technology development to establish the GOOS. Various operational activities have been carried out by Governmental Agencies, Prefectural Governments, and universities. The Japan Meteorological Agency has been in charge of oceanographic observations with initiatives in IGOSS and GLOSS, and recently established its El Niño Monitoring and Prediction Centre. The Hydrographic Department, Japan Maritime Safety Agency, is operating the Japan Oceanographic Data Centre of IODE, and conducting oceanographic observations and marine pollution monitoring. The Japan Fisheries Agency is responsible for living resources and for related marine environmental issues, while making remarkable contributions to monitoring of the coastal zone and the ocean.

The Environment Agency has been carrying out pollution monitoring in the coastal zone and adjacent seas of Japan. The Ministry of Posts and Telecommunications has been observing rainfalls, oil pollution, and offshore currents by using satellites, and airborne and coastal radars. The Ministry of Construction has been conducting various researches on sea level rise and its socio-economic impact from the view point of coastal zone conservation.

It should be stressed that Japan has been actively participating in training, education and mutual assistance (TEMA), and technology transfer in marine sciences and services within frameworks of IOC/WESTPAC, and by various international and bilateral cooperation programs. Japan provides the opportunities for scientists and technicians in the WESTPAC region to participate in the training course on NEAR-GOOS data management.

This report, prepared by the Liaison Conference on GOOS of the Inter-Ministries and Agencies, describes Japanese GOOS activities in 1999.

2. THE NATIONAL MECHANISM FOR DEVELOPMENT OF GOOS

The National Committee for IOC, the National Commission for UNESCO of Japan, is the focal point of the IOC activities as a whole for national and international coordination. The official correspondence and international coordination with the IOC Secretariat regarding GOOS have been done under the responsibility of the Committee. The Committee has established the NEAR-GOOS Working Group of the Inter- Ministries and Agencies for development of the implementation plan of the North-East Asian Regional GOOS, in the Japan Sea, East China Sea and Yellow Sea.

The Liaison Conference on GOOS of the Inter-Ministries and Agencies provides a forum among the Governmental GOOS members for the further coordination of the GOOS-related activities. The Sub-committee for GOOS, within the National Committee for SCOR of the Japan Science Congress, is coordinating scientific aspects of the GOOS.

NEAR-GOOS has come in to operational phase on 1 October 1996, as a result of Resolution of WESTPAC-III in February- March 1996 according to the Operational Manual adopted by the First NEAR-GOOS Coordinating Committee in September 1996. The manual

is published by IOC and the Japan Oceanographic Data Center in English and by the Japan Meteorological Agency in Japanese.

Japan Science Congress established the GOOS Sub-committee within the National Committee for SCOR, to investigate a long term observational system for the ocean. In March 1997, the Sub-Committee published a report, 93 pages in Japanese, to propose a system based on the Report of OOSDP.

3. PARTICIPATION OF THE GOVERNMENTAL ORGANISATIONS IN PLANNING, DEVELOPMENT AND IMPLEMENTATION OF GOOS

The agencies involved include: Science and Technology Agency (STA); Environment Agency; Ministry of Education, Science and Culture (MONBUSHO); Japan Fisheries Agency (JFA); Ministry of Transport (MOT); Japan Maritime Safety Agency (JMSA); Japan Meteorological Agency (JMA); Ministry of Posts and Telecommunications (MPT) and Ministry of Construction (MOC).

For details of their activities see the Japan National Report on GOOS in the Annexes to the report of the 4th session of the Intergovernmental Committee for GOOS (I-GOOS), Paris, June 23-25, 1999 (GOOS web site or hard copy).

4. ACTIVITIES RELATED TO GOOS TO BE SUPPORTED OR IMPLEMENTED BY THE GOVERNMENTAL ORGANISATIONS

4.1 SCIENCE AND TECHNOLOGY AGENCY (STA)

4.1.1 Introduction

STA has been coordinating "the Pacific Ocean Observation and Research Initiative (TYKKI)" in cooperation with the United States since 1993, in order to enhance the activities on observation and research in the Pacific Ocean. This cooperative work will contribute to develop the GOOS in this region (for details see Japan National Report on GOOS in Annexes to I-GOOS-IV report).

By using the Special Coordination Funds for Promoting Science and Technology, STA has supported the development of a multi-purpose, automated moored buoy system with capability of easy deployment and multi-parametric observation, and the development of real time transmission of the observed data via satellites on a routine basis for weather forecast.

4.1.2 The Japan Marine Science and Technology Center (JAMSTEC)

1) TRITON project (Triangle Trans-Ocean buoy Network)

JAMSTEC is developing a surface moored-buoy network named TRITON (Triangle Trans-Ocean buoy Network) for observing oceanic and atmospheric variability in the Pacific Ocean and its adjacent seas in cooperation with interested Japanese and foreign agencies and institutions. The principal scientific objective is to understand variations of ocean circulation and heat/salt transports with emphasis on ENSO, the Asian monsoon, and decadal scale variability that influences climate change in the Pacific and its adjacent seas. In its first phase, the buoy network will be established mainly in the western tropical Pacific Ocean, and harmonised with TAO-ATLAS buoys which are presently maintained by NOAA's Pacific Marine Environmental Laboratory.

JAMSTEC has already deployed nine (9) TRITON buoys in the western tropical Pacific Ocean, and the data obtained by using this system have been distributed like the TAO data on the TRITON homepage (http://jamstec.go.jp/jamstec/TRITON) and through the GTS since April 1999. In the future, we are planning to set a similar network in the Indian Ocean in October 2000, upon successful deployment in the western tropical Pacific Ocean. Deployment will be started as a pilot study for three years and be coordinated with other

program like JASMINE, the Indian National Date Buoy program, Indonesian climate studies, etc.

However, there are some difficulties in operation: one of the TRITON buoy had stopped satellite data transmission on April 22, 1999. The tower of the buoy had been lost where only a part of a tower-leg remained. A vessel may have pulled down the tower intentionally. Aside from this buoy, one (1) buoy had started drifting on March 13 and was recovered on 16 March. The TRITON buoy wire may have been broken at 500 m depth by towing from some boat, and two (2) TRITON buoys have started drifting. If this kind of damages is continuous, the deployment of TRITON buoys in the Pacific and in the Indian Ocean might be delayed.

2) Tropical Ocean Climate Study

The objective of the Tropical Ocean Climate Study (TOCS) is to achieve better understanding of ocean circulation in the warm pool affecting the ENSO phenomena and global climate change. As part of TOCS, JAMSTEC has deployed subsurface ADCP moorings to detect daily, seasonal and year-to-year changes of equatorial and low latitude western boundary currents.

JAMSTEC has conducted two cruises per year since Japanese Fiscal Year 1993 (April 1993-March 1994) using R/V *Kaiyo*, and increased to three cruises per year since FY 97 using the R/V *Kaiyo* and R/V *Mirai*. Hydrographic and atmospheric measurements have been carried out using CTD, shipboard-ADCP, and radiosonde. These cruises also maintain the JAMSTEC subsurface ADCP array and TAO array in the western Pacific. The TRITON buoy operations are carrying out in conjunction with TOCS.

3) Kuroshio Extension Study

JAMSTEC has been conducting oceanographic observations in the Kuroshio extension and adjacent region in order to understand physical processes associated with the inter-gyre exchange of heat and potential vorticity and to understand ocean-atmosphere mixed-layer processes.

4) Arctic Ocean Research

JAMSTEC has been conducting meteorological, glaciological, and oceanographic observations in the mid-Arctic Ocean in cooperation with US and Canada.

5) Ridge Flux Study

JAMSTEC is now involved in the Ridge Flux Project, aiming at quantitative estimation of the total energy and mass flux from the interior of the earth to the hydrosphere and atmosphere through geophysical and geochemical observation on mid-oceanic ridges and in active back-arc basins.

The diving cruise using manned submersible SHINKAI 6500 were carried out at the southern East Pacific Rise in collaboration with the U.S.A. in 1997. During the cruise, JAMSTEC and other institutions deployed long-term seafloor monitoring stations at two (2) different hydrothermal active areas located at 17°S and 18°S. In 1998, about one (1) year later after the diving cruise, the monitoring stations were recovered in the cruise of ALVIN/ATLANTIS, and we obtained the data of one (1) year-long variability of hydrothermalism.

6) Primary Production Research

JAMSTEC has started a program to observe phytoplankton and its primary production in equatorial upwelling regions and in the equatorial western Pacific using ocean LIDAR (laser radar), in addition to traditional measurement methods. This research program helps to build

data sets of phytoplankton distribution originated from the data of satellite-borne ocean color sensors that are received at a ship-board satellite receiving station.

7) Zooplankton Research

JAMSTEC has been studying a measurement technique to obtain vertical profiles of size and density distribution of zooplankton. JAMSTEC is planning to use and improve the technique of *in-situ* measurement to study processes in the lower tropic region and in Japanese coastal waters.

8) Research and Development on Ocean Observation System

JAMSTEC has been researching and developing the following new ocean observation systems;

a) Ocean Acoustic Tomography System
b) Ocean LIDAR System
c) Surface Mooring Buoy Network
d) Ice Ocean Environment Buoys
e) Large Size Research Vessel

4.1.3 The National Space Development Agency of Japan (NASDA)

Research and Development of Satellite Remote Sensing

The National Space Development Agency of Japan (NASDA) has developed and launched the R/S satellites to observe the sea surface temperature, ocean color (ADEOS/OCTS, etc.), sea surface wind (ADEOS/NSCAT), and so on, and conducted analysis of satellite oceanography using both foreign and Japanese earth observing satellites. Also, NASDA has developed the Earth Observation Information System (EOIS) for easier public access to the earth observation data.

4.2 ENVIRONMENT AGENCY

4.2.1 Marine Pollution Survey and Monitoring

The Environment Agency has conducted various surveys required in promoting environmental administration for protection and preservation of the marine environment. The Environmental Agency has carried out marine pollution monitoring of waters around Japan since 1975. Water temperature, salinity, concentration of nutrient salts, heavy metals, etc., in the sea water are monitored at stations on lines which cross the ocean currents around Japan and extend from the coast to the designated waste dumping areas in the open sea. Concentration of heavy metals in the bottom sediment and zooplankton are also monitored. In order to grasp the environmental pollution situation by chemical substances, the Environment Agency conducts every year environmental monitoring of the water, bottom sediment, fish and shellfish in the coastal zone.

At local level, the prefectural governments monitor annually the water quality of public water areas, i.e., rivers, lakes, coastal waters, ports and harbours, etc., and the results of the monitoring are compiled by the Environment Agency.

4.2.2 The Survey of Biological Environment on Coastal Area

The locations, areas and types of tideflats, seaweed beds and coral reefs were investigated in 1978 and 1989-1992, by field survey or using aerial photographs and/or other materials. Then existing and disappeared areas of tideflats, seaweed beds and coral reefs in 1989-1992 have been plotted on 1:200,000 scale maps.

4.2.3 Research projects for Marine Environmental Protection

Global Environment Research Program of the Environment Agency has supported research projects on ocean environment and marine pollution since 1990. In FY 1996, 14 national institutes and 24 universities conducted 4 research projects; (1) Impact of environmental load through large river on marine ecosystem in Bohai and East China Seas, (2) Studies on movement of hazardous chemicals in east-Asian seas, (3) Study on the detection of ecological changes and land-based loading effects in the Asian marginal seas, and (4) Studies on preservation of coral reef ecosystems.

The Centre for Global Environment Research (CGER) of the National Institute for Environmental Studies is conducting a marine environmental monitoring program, including marine pollution monitoring using analyses of pollutants concentrated in marine organisms, and studies of greenhouse gas exchange between the atmosphere and ocean using ships-of-opportunity.

4.3 MINISTRY OF EDUCATION, SCIENCE, SPORTS AND CULTURE (MONBUSHO)

4.3.1 Physical, chemical and biological studies on monitoring of marginal seas for ocean forecasting (NEAR-GOOS)

The International Cooperative Research Program of NEAR-GOOS was carried out in 1998 at Japanese universities, and it will be continued for fiscal years of 1999-2003 by the Grant-in-Aid for Scientific Research on Priority Areas (B). GOOS will provide accurate description of the present state of the oceans, including living marine resources, and will provide forecasts of sea conditions. GOOS is intended to be an operational system for observations, modelling and analysis of ocean variables needed to support marine activities. The North East Asian Regional Project of Global Ocean Observing System, NEAR-GOOS, was started in 1997 according to Recommendation of IOC Sub-Commission for the Western Pacific, WESTPAC, held in 1996 in Tokyo. Oceanographic data collected in the Japan Sea, Yellow Sea and East China Sea are to be exchanged at quasi-real time mode to make daily mapping of temperature, salinity and ocean currents. Four countries facing the marginal seas, China, Japan, Republic of Korea, and Russian Federation, have set up a NEAR-GOOS Co-ordinating Committee. The oceanographic data reported through GTS or Internet to the NEAR-GOOS real-time Database on the Internet are open to everybody, and the data are sent to the NEAR-GOOS Delayed Mode Database, which is open to everybody. Anybody who makes observations in the marginal seas is encouraged to report the data to the NEAR-GOOS Database to share the data. The daily mapping of the sea conditions is the basis for ocean forecasting. Although NEAR-GOOS is carried out in the seas of dense observations, the present data are not sufficient for accurate ocean forecasting, and the research groups of Japanese universities utilise several new methods, such as ADCP equipped to ferry boats, drifters, pop-up floats, satellite data, and so on. Among them, submarine cables between islands and peninsulas are used to detect electric potential difference caused by ocean currents. The measurements are made at Pusan, Korea, and at Aomori, Miyake-jima, Fukuoka and Okinawa, Japan. Research vessels of the Ocean Research Institute are used to calibrate the measurements. The research group is developing a numerical model for forecasting based on the daily mapping of NEAR-GOOS. Biological and chemical studies are also included. Transportation and dispersion of chemical substances and plankton are to be estimated from the forecasted field of ocean currents. Weather forecasting is based on the meteorological data transmitted in a real time mode. The expansion of human activities on the sea and in the ocean requires ocean forecasting, and the data sharing through electric communication is essential. International cooperation is very important, as demonstrated by the NEAR-GOOS.

4.3.2 International Cooperative Research

The development of GOOS has been supported by Monbusho through Scientific Grants-in-aid for International Research Programs, and the subjects ongoing are as follows.

1) Mussel Watch: Marine Pollution Monitoring in Asian Waters: 1997-1999

In the Asia-Pacific project of the International Mussel Watch, monitoring, collection and analysis of hazardous chemicals and substances in the coastal marine areas of India, Vietnam, Indonesia, Malaysia, Philippine, Taiwan, Republic of Korea, Thailand, and others will be made by Japanese research group and the invited researchers from these countries. Activity for capacity building is also included in the project. (S. Tanabe, Faculty of Agriculture, Ehime University, shinsuke@agr.ehime-u.ac.jp)

2) Observations and models for ocean forecasting of marginal seas: 1998-2000.

Overseas travels of Japanese university scientists engaged with NEAR-GOOS projects, and invitations to foreign scientists, are supported by this fund. In 1998, instructors for training workshop in Bali for IYO Cruise of T/S Kagoshima Maru, mission to and from Vladivostock for NEAR-GOOS data handling, Korean scientists for voltage measurements by submarine cable, and others were supported, (Keisuke Taira, Ocean Research Institute, the University of Tokyo).

4.4 JAPAN FISHERIES AGENCY (JFA)

4.4.1 Oceanic Research

1) Annual variation of surface layer temperature in the tropical seas (1987-)

Hydrographic observations have been made by the fisheries experiments and the fisheries training vessels of the local governments in the tropical area of the Pacific and Indian Ocean to establish a temperature observation network by using fishing boats operating in these areas.

2) Oceanographic structure and biological productivity in the North Pacific Ocean and the Kuroshio/Oyashio area (1997-2001).

Physical, chemical and biological observations were made under the WOCE program to elucidate the relationship between ocean and the lower trophic level biological productivity.

3) Exploration of Kuroshio and adjacent areas(1986-1999)

Cooperative studies with China have been made since 1986. The relationship between plankton production and the spatial accumulation of pelagic fish eggs and larvae, and the physical structure of the ocean are studied.

4.4.2 Researches on Environmental Issues

1) Ultraviolet effect on interrelationship between phytoplankton and zooplankton

The influence of enhanced UV-B radiation on the interrelationship between marine phytoplankton and zooplankton was investigated.

2) Monitoring methodology for marine pollution by hazardous chemicals accumulated in organisms (1997-2001)

This project intends to establish methods to evaluate marine pollution by hazardous chemicals by determining the chemicals accumulated in marine organisms such as mussel, fish, and squid.

3) Preservation of coral reef ecosystems (1997-1999)

The biodiversity in coral reefs around the Ryukyu Islands, its structure and function are investigated, and methods of its evaluation and monitoring technique are developed.

4.4.3 Living Resources Research

Numerous research projects on marine and fresh water living resources have been operated under the direction of the Fisheries Agency. Representative ones are as follows:

1) Fish resources investigations in the northern North Pacific (partly 1955-)

Ecological and biological investigations for salmonids, Alaskan pollack, squids, etc. are carried out.

2) Fish resources investigations in the far seas (partly 1953-)

Ecological and biological investigations for the resources of demersal and pelagic fishes are made in the North Atlantic, tropical Pacific.

3) Comprehensive study of the variation of the oceanic environment and fish populations in the North-western Pacific (1997-2002).

This project intends to clarify the influence of the oceanic environment, phytoplankton and zooplankton on the resource variation of walleye pollock and saury, and to develop ecosystem forecasting models.

4.5 MINISTRY OF TRANSPORT (MOT)

4.5.1 NOWPHAS

NOWPHAS (Nationwide Ocean Wave information network for Port and Harbours), the Japanese coastal wave observation and analysing system, has been operated since 1970 by the Ports and Harbours Bureau of the Ministry of Transport and its associated agencies including the Port and Harbour Research Institute (PHRI).

As of the end of March 1999, observed wave records of 49 NOWPHAS offshore stations (49 stations for wave height and period, 30 stations for wave direction: the number of observation points will grow up to 53 in 2000) are being collected and analysed at PHRI.

4.5.2 Doppler Type Wave Directional Meter (DWDM)

A Doppler Type Wave Directional Meter (DWDM) was developed by PHRI in 1995. DWDM integrates the Ultrasonic Wave Gauge (USW) and the Current Meter Type Wave Direction Gauge (CWD), and is able to measure directional wave spectra in deep water by applying the Doppler principle.

DWDMs will be the principal wave gauges of NOWPHAS and have already been installed at 9 stations in March 1999. (13 stations by 2000)

4.5.3 Tsunami and Infragravity Wave Observation

NOWPHAS contributes to the exact offshore tsunami profiles of the 1993 Hokkaido-Southwest-Earthquake, 1994 Hokkaido-East-off-Earthquake, and 1996 Irianjaya-Earthquake.

The newly developed continuous data acquisition system without intervals takes an important rule for Tsunami disaster prevention and coastal infragravity wave study. In March 1999, the continuous data system had already been applied at 13 NOWPHAS stations.

4.6 JAPAN MARITIME SAFETY AGENCY (JMSA)

4.6.1 Ocean Survey

The Hydrographic Department, JMSA, is regularly conducting oceanographic observations of ocean current, water temperature, salinity, etc., in and around Japanese waters and publishes various products including a bi-weekly oceanographic bulletin. As a part of the implementation of WESTPAC Programs, Japan Antarctic Research Expedition (JARE), etc., the Department is also carrying out observation of ocean currents, water temperature, etc. and precise observation of deep sea currents by using oceanographic mooring systems and drifting buoys in the North Pacific Ocean and the Southern Ocean. It also participates in the WOCE program and has completed the one-time and P8 lines. It initiates oceanographic observations including CTD, XBT, Drifters in the subarctic gyre in the North Pacific, a 5-year program starting from 1997.

4.6.2 Marine Pollution Survey and Monitoring

In and around Japanese waters, major bays and harbours, as well as in the western Pacific area, mid-latitude areas in the North Pacific Ocean, and the Southern Ocean, the Hydrographic Department, JMSA, is carrying out marine pollution survey and monitoring of sea water, bottom sediment, oil, PCB, heavy metals and radioactive materials for their concentrations and interannual changes. In order to find diffusing conditions of pollutants, observation of deep sea currents is also being conducted.

4.6.3 Tidal Observation

In order to monitor the sea level, the Hydrographic Department, JMSA, has been carrying out tidal observation at 29 tide stations around Japan, which are telemetered to the head office and the station at the Showa Base in the Antarctica, which contributes to GLOSS and WOCE.

4.6.4 Oceanographic Data and Informational Services

The Japan Oceanographic Data Centre (JODC) has been serving as the sole comprehensive oceanographic data bank in Japan, collecting, processing, managing and supplying various marine data and information. The JODC also acts internationally as an organisation representing Japan in the International Oceanographic Data and Information Exchange (IODE) system and as the Responsible National Oceanographic Data Centre (RNODC) for IOC/WESTPAC Program, IGOSS, MARPOLMON, and ADCP. In recent years, JODC has also been contributed to global climate programs such as WOCE and JGOFS. The JODC has been organising the WESTPAC training course on oceanographic data management every year since 1982, in support of IOC and the Japanese Fund-in-Trust. This training course will be shifted to the NEAR-GOOS training course from 1997.

4.7 JAPAN METEOROLOGICAL AGENCY (JMA)

JMA operates six research vessels in the seas adjacent to Japan and the western Pacific Ocean for oceanographic and marine meteorological surveys. JMA has been conducting oceanographic observations along the fixed lines in the waters around Japan every season for more than 50 years, and from the south coast of Japan to the equatorial region in the western North Pacific over 30 years on a semiannual basis. Since 1992, oceanographic surveys in the western North Pacific have been expanded from twice to four times per year. These observations cover the fields of physical, chemical and biological oceanography as well as marine meteorology, aerology and radar meteorology. The observations of greenhouse gases and ozone depleting substances are implemented within the framework of the Global Atmosphere Watch (GAW) of WMO, and the observed data are distributed through the World Data Centre for Greenhouse Gases (WDCGG) operated by JMA to users all over the world. The marine pollution monitoring is being made under the MARPOLMON of IOC.

JMA plans to launch a new research vessel, *Keifu Maru*, in late 2000, to enhance the monitoring of the oceanic conditions in the western Pacific and understand the mechanism responsible for oceanic variability on various temporal and spatial scales, especially the role of the ocean in climate change.

JMA deploys three moored ocean data buoys in the seas adjacent to Japan to obtain three-hourly meteorological and oceanographic data via the Geostationary Meteorological Satellite (GMS) operated by JMA, and puts them onto the Global Telecommunication System (GTS) of WMO on a real-time basis. Furthermore, JMA has deployed PALACE floats in the western North Pacific and has been providing its temperature profile data via GTS.

For monitoring of tsunami, storm surge and unusual tide, JMA operates 84 tidal stations and the huge tsunami observing apparatus at 76 sites in coastal areas and islands. In this connection, it is particularly worthy to note that JMA initiated sea level observation by a pressure-type gauge at Minamitorishima in March 1996. Monthly mean sea level data of the 10 tidal stations are provided to GLOSS of IOC and to the IGOSS Sea-Level Program in the Pacific (ISLP-Pac).

JMA has recruited two merchant ships equipped with XBT observation facilities cruising in the Pacific Ocean and the Indian Ocean to collect subsurface temperature data. Since 1998, an additional two ships-of-opportunity have been making sampling in the North Pacific under a cooperative project between JMA and the National Oceanic and Atmospheric Administration (NOAA). Further, JMA is making an effort to have more merchant ships and fishing boats as well as research vessels report more data on marine meteorology, sea surface and subsurface temperatures and ocean surface current. As one of the responsible members of the WMO Marine Climatological Summaries Scheme (MCSS), JMA is publishing the statistics of marine meteorological elements for the North Pacific.

The GMS, stationed at 140E above the equator, provides information about cloud distribution and height, upper and lower wind inferred from cloud motion and water vapour motion, and sea surface temperature. As the successor to GMS, the first Multi-functional Transport Satellite (MTSAT), a three-axis stabilised satellite, will be launched in August 1999 to enhance the capability of observations by adding more signal quantization and a new infrared channel.

JMA collects marine meteorological and oceanographic data through GTS, and the observed data are also reported to JMA by Japanese domestic organisations and universities. JMA issues the *Monthly Ocean Report* containing the latest data/information on oceanic conditions for domestic and foreign users and the *El Niño Monitoring Report* (in Japanese) containing a summary of oceanic and atmospheric conditions in the equatorial Pacific for domestic users on a monthly basis. JMA has been operating the Ocean Data Assimilation System (ODAS) since the beginning of 1995 and some products of the ODAS appear in the *Monthly Ocean Report*.

JMA issues the *Monthly Report on Climate System* which contains the oceanographic information including ODAS output together with atmospheric products for climate monitoring. Most of the contents of this publication are exchanged with other national Meteorological Services through the WMO Distributed Data Base (http://ddb.kishou.go.jp).

In 1995, because of great interest in the scientific community in the historical observations, JMA started to conduct a project to construct a digital data base of the pre-1933 merchant ship data archived in the Kobe Collection by the Nippon Foundation. The Kobe Collection is historical surface marine meteorological data observed by Japanese Voluntary Observing Ships for the period from 1890 to 1960. In the collection, reports by merchant ships and research vessels number about 6.8 million and those by the Japanese Imperial Navy number about 5 million. All the data by merchant ships after 1933 were digitised in 1960/61 and have already been included in the Comprehensive Ocean-Atmosphere Data Set (COADS). About 1.6 million of the data have already been keyed since the start of the project. Among them, about 1 million quality-checked data were made available on a CD-ROM and

distributed to interested organisations and researchers in March 1999. JMA is making efforts to digitise as many data as possible.

JMA is also in charge of the IGOSS Specialised Oceanographic Centre (SOC) for the Pacific Ocean to collect and to process wide-ranging oceanographic data, and to disseminate products through the Meteorological Radio Facsimile Broadcasting and the *Monthly Ocean Report* on an operational basis.

The NEAR-GOOS Regional Real Time Data Base (RRTDB), collecting the real time *in-situ* observational data in East Asian seas, has been operated by JMA since 1997. The number of registered organisations of the RRTDB has steadily increased to 33 as of June 1999. With regard to access to the RRTDB, access to the RRTDB homepage has increased from around 500 hits per month in 1997 to over 2000 hits per month in 1999. The ftp access number also increased and has been around 1000 hits per month. JMA published the Japanese version of the "Operational Manual for the NEAR-GOOS Data Exchange" revised at the third session of the NEAR-GOOS Coordinating Committee, and distributed them in the Japanese oceanographic community to encourage participation in NEAR-GOOS data exchange.

For the safety of ships' navigation, JMA issues forecasts and warnings on marine weather as well as forecasts on ocean waves in the vicinity of Japan and the western North Pacific. In addition, JMA issues forecasts and information on sea ice in winter. Another responsibility of JMA is to disseminate meteorological forecasts and warnings for the western North Pacific and the South China Sea to ships via INMARSAT under the Global Maritime Distress and Safety System (GMDSS). Furthermore, JMA issues information to support the activity for combating marine pollution (oil spill) in case of emergency under the framework of Marine Pollution Emergency Response Support System (MPERSS) conducted by WMO.

JMA plans to start El Niño forecasting on an operational basis by using the coupled ocean-atmosphere model, and development of an ocean data assimilation system for the mid-latitude region of the North Pacific, which introduces ocean surface topography data obtained by TOPEX/POSEIDON satellite.

4.8 MINISTRY OF POSTS AND TELECOMMUNICATIONS (MPT)

4.8.1 Ocean oil pollution detection by Airborne Imaging Radar

The Communications Research Laboratory (CRL) developed an 9.5 GHz Side-Looking Airborne Radar (SLAR) system for the surveillance of oil pollution over the ocean in 1986. SLAR has a very high sensitivity in oil slick detection over the ocean. CRL also has been developing the 9.5GHz airborne high resolution Synthetic Aperture Radar(SAR) since 1993. This imaging radar will be useful to monitor marine oil pollution, and to observe currents and so on.

4.8.2 HF Doppler radar system for measurement of ocean current

CRL developed an High Frequency (25MHz) Doppler radar system for continuous measurement of ocean current distributions and sea states over a wide range. In the actual observation, dual ocean radars are located at the coast to monitor ocean current vectors.

4.8.3 Airborne laser altimeter for sea ice measurement

CRL developed an airborne laser altimeter to measure the distribution and height of sea ice to an accuracy of an order of cm. The experiments were made in February 1992 and 1993 for the sea ice of the Sea of Okhotsk.

4.9 MINISTRY OF CONSTRUCTION (MOC)

The MOC is conducting research through the Geographical Survey Institute (GSI). The GSI developed a method for assessing socio-economic loss in an inundated area. A

Pilot study was performed in the areas of Nagoya, Japan, and Bangkok, Thailand. To discriminate net sea level rise from crustal deformation, GSI connected some tide gauge stations to the global datum using VLBI and GPS. The GSI has conducted "fundamental Survey of the Coastal Area" since 1972. On the basis of the research, GSI compiled maps useful for counterplan against flood, conservation of coastal environment, coastal fishery etc. Using aerial-photographs, Multi MSS, and LANDSAT TM images, GSI studied change in natural environment especially damage to coral reefs by red soil.

The Coastal Movements Data Center (CMDC) was established in 1966 as an organisation that uniformly compiles tidal data from tide gauge stations of Japan Meteorological Agency, Hydrographic Department, Geographical Survey Institute and others.

V.10 NETHERLANDS

1. STATEMENT OF DR JAN STEL (LETTER TO P. BERNAL OF 29/6/99)

From the beginning of the development of GOOS within the IOC, the Netherlands has had a keen interest in this challenging program. Our interest has been expressed during the last IOC Assembly during which we made a substantial contribution to the GOOS Trust Fund. We are pleased that in close co-operation with the director of the GOOS GPO a challenging plan has been developed and is being implemented for spending this contribution to support the development of the Coastal Module of GOOS, the relationship between GOOS and LOICZ and Capacity Building activities.

In relation with last years Parliamentary elections a report, cross cutting the different Ministries involved in monitoring activities in the Netherlands, was made to develop a coherent national approach towards global monitoring systems. GOOS was of course an important element of the report *Improved Monitoring of System Earth, Dutch Contribution to International Monitoring Systems*. I enclose a copy of the report and kindly ask you to distribute it to the IOC Member States. The report also has been distributed at the I-GOOS meeting. From the report you learn that among others GOOS is taken seriously in my country as a strong case is made for increasing our involvement and for Capacity Building in relation with GOOS. A follow-up will be started soon and after that a formal governmental decision is expected. Because of this we cannot yet make a formal commitment which is backed by a formal Government decision. I hope, however, that this letter demonstrates our sincere interest and support of GOOS (and other global monitoring systems).

Another indication of our involvement in GOOS is the fact that the present chairman of EuroGOOS is a Dutchman, being Ir. D. Tromp. He is heading the National Institute for Coastal and Marine Management (RIKZ) of the Rijkswaterstaat. At the same institute the Secretariat of the national EuroGOOS Committee is based. Moreover our research council has taken the lead in CLIVARNET, which is a major contribution to EuroCVLIVAR and CLIVAR. In the framework of this program the Dutch RV *Pelagia* is going to make two research cruises in 2000 and 2001, around Africa.

As an annex I am including, on behalf of the Royal Netherlands Meteorological Institute (KNMI) and the Netherlands Institute for Sea Research (NIOZ), a statement of these two institutes. This statement underpins our sincere interest in the IOC and GOOS.

In conclusion we want to stress the importance and our endorsement of GOOS.

2. CONTRIBUTION OF KNMI AND NIOC (NETHERLANDS) TO GOOS

Prepared for the GOOS Commitments Meeting, 5-6 July 1999

The Royal Netherlands Meteorological Institute (KNMI) and the Netherlands Institute of Sea Research (NIOZ) recognise the importance of a global ocean observing system. This importance derives from the need for global climate - and ocean - observations, as recently reaffirmed by COP and SBSTA of the United Nations Framework Conference on Climate Change and from the need of management and economic exploitation and sustainable development of the European Atlantic shelf seas and the Dutch coastal zone. Therefore, both institutes actively participate both in GOOS and in EuroGOOS and fully respect the GOOS Design Principles and Principles of Involvement as laid down in the GOOS prospectus 1998. Both institutes have taken note of the definition of the GOOS initial observation system (document IOC-WMO-UNEP/I-GOOS-IV/8), but they understand that repeat hydrographic sections are also considered as important elements of GOOS (as already expressed by the Dutch delegation to I-GOOS-IV). Such sections are crucial to the study of oceanic decadal variability in the Meridional Overturning Circulation and for studies of rapid climate change.

KNMI

Routine Observations by Voluntary Observing Ships and Drifting Buoys

KNMI makes a number of contributions to the level 1 elements of the GOOS initial observing system. The first is the Voluntary Observing Ship program of the World Weather Watch. Under this program, operated by the WMO, over 7000 ships make meteorological and oceanographic observations, some with the help of XBTs. Data are disseminated in real-time and archived in global collecting centres. Dutch ships contribute some 90000 observations annually. KNMI has developed software packages (TURBO1 and TurboWIN) to facilitate compilation, encoding and transmission via Inmarsat. These packages will be introduced for all seafaring nations and are available at WMO. KNMI also contributes to the European Group of Ocean Stations (EGOS). As part of this program 18 drifting buoys are deployed in data sparse areas in the North Atlantic Ocean. KNMI is responsible for 2 of these buoys. These buoys measure sea level pressure and sea surface temperature. Some measure winds and current as well.

Other KNMI contributions

KNMI also participates in several research projects that are relevant for GOOS, such as ESODAE, a regional contribution to GODAE, and the development of methods for the initialisation of the ocean in seasonal climate prediction systems (jointly with ECMWF). Finally, KNMI collaborates with Rijkswaterstaat in the Meetnet Noordzee, a network of fixed observation stations in the southern North Sea.

NIOZ

Repeat hydrography

NIOZ participates in the ocean-observation component of the internationally co-ordinated CLIVAR program. A contribution to global ocean monitoring is performed by carrying out hydrographic observations on a section in the North-Atlantic ocean (former WOCE AR7E section covering a transect from Ireland to Greenland) in 2000, 2002 and 2004. This section is one of the repeat sections which have been identified for the North Atlantic Ocean. The planning of this ocean monitoring is performed in close collaboration with the German BSH.

Other NIOZ contributions

NIOZ participates also in projects which will be performed in the framework of the Dutch contribution to CLIVAR. Studies on interbasin exchange between the Indian Ocean and Atlantic Ocean focussing on the contribution of Agulhas rings are performed in 2000-2003 in collaboration with KNMI and Utrecht University (IMAU). NIOZ is responsible for the observational part of this program with expeditions in 2000 and 2001. In addition to these studies on the effect of Agulhas rings an array of current meter moorings will be deployed for one year (2000-2001) in the Mozambique channel between Madagascar and Mozambique in order to obtain information on the magnitude and variability of the Mozambique current. The datasets obtained will be made available through international data centres.

NIOZ is one of the partners in an EU proposal on the use of ferry-boxes in operational oceanography. This proposal aims to initiate the ferry component of the EuroGOOS observational system. The existing system installed on a ferry in the Dutch Wadden Sea forms one of the components of this European initiative.

V.11 NORWAY

PRESENTATIONS BY NORWEGIAN AGENCIES

V.11.1 NORWEGIAN METEOROLOGICAL INSTITUTE (DNMI)

DNMI is an operational institute with highly specialised services to marine activities, industry and authorities; coastal navigation and environmental protection, offshore oil production and exploration, high sea shipping for economic routing advice and safety support, and support to fisheries and coastal aquaculture.

DMNI has experience in operating GOOS type services for the North East Atlantic adjacent sea areas; providing services and products from the domains of physical, chemical, and biological oceanography. It has a clear priority to user interaction, tailoring services to their needs, and accordingly professional Quality Assurance procedures.

DNMI is strongly in support of the development of GOOS.

Its specialised Marine Forecasting Center (MFC) has the position and skills required to interact with and contribute to the GOOS implementation and future operation. Typical points of action or contribution will be:

- facilitating exchange of real time oceanographic measurement data, manily on waves. Norway already contributes to GLOSS, VOS and DBCP and others;
- implementation assistance and 'best practice' advice where new national services are established;
- offering a lead role in knowledge transfer regarding availability, quality and user satisfaction of GOOS type services around the world.

DNMI and other cooperating institutes organised and operated a 'Pilot GOOS' named 'HOV' in the period 1990 - 1994. Its main objectives were to organise and operate services in accordance with identified marine users needs. The main users were representing offshore industry, aquaculture, marginal ice zone fisheries, and coastal environmental protection.

This experiment initiated a variety of new marine services still in operation, and left a base of experience in multidisciplinary 'operational skills', such as to run an 'end-to-end' operational service, with its administrative, budgetary, scientific and technical aspects, choreographed to produce end results to the satisfaction of the users.

An independent governmental assessment committee decided that HOV had achieved the goals set up for it, but also had to recognise obstacles and difficulties that mainly were due to the cultures of the participating organisations.

PARTICIPATION:

Con's : Difficulties to team up national organisations, either being in competition or having different perspectives on GOOS. Reluctance to 'shift resources (funding) from science to operation'. Lack of 'culture to exchange'. Complex governmental fuding mechanisms and distributions of responsibilities. Ongoing but unpredictable commercialization of services originally funded by governments.

Pro's : Closer cooperation and interaction with the marine user communities and other domains of activity and responsibility. Broader regional and global coordinations and cooperations. Synergy benefits due to exchange of data, tools and resources. Significant feedback to science. Enhanced influence at the political level, demonstrating applications of operational oceanography and follow-up of international conventions (re. GOOS-98).

THE INTERGOVERNMENTAL PROCESS

The GOOS intrastructure, as a partial analogy to WWW (World Weather Watch):

It will bring siginificant synergy benefits to operational oceanography due to:

- data exchange, including format and QA standardization;
- knowhow exchange, both in the scientific and technological sense;
- broader reference for developing countries, re. capacity building.

Therefore:

The intergovernmental process must facilitate participation through enhanced lobbying and promotion of GOOS towards the relevant political levels, in particular signatories of the international conventions that constitute the legal framework in the foundation of GOOS.

Further:

In the light of the fact that few (if any) of the existing GOOS relevant national agencies or institutes have the fully adequate capacity to foster GOOS alone, it must be explained to governments that we are looking for new organisational creations, for instance national or international cooperation consortia composed of partners from different mother organisations.

V.11.2 NANSEN ENVIRONMENT AND REMOTE SENSING CENTRE

Marine Products and Services

Ice Information Products
- ! Arctic climate monitoring and predictions
- ! Ship navigation and routing
- ! Offshore Arctic operations

Ocean and Coastal Monitoring
- ! Oil spill detection
- ! Algae bloom monitoring
- ! High resolution wind retrieval

Ocean Modelling and Data Assimilation
- ! Circulation and tracer mondelling
- ! Ecosystem modelling
- ! Data Assemilation

Climate Module Examples

- ! Sea-ice concentrations from passive microwave satellites (monthly averages)
- ! Modelling Arctic ice cover
- ! Arctic total sea ice area for given periods
- ! Arctic total sea ice area departures for given periods
- ! Arctic multi-year sea ice area for given periods
- ! Modelled sea ice thickness
- ! Satellite-derived ice concentrations
- ! Modelled and satellite-derived sea cover
- ! Eddy kinetic energy

Operational Services

Sea Ice Users
- Icebreakers

Merchant Vessels
Off-shore Industry
Fisheries
Weather Services
Regional Authorities
Coast Guard
Research Expeditions

Northern Sea Route
historical sailing routes

Ice Type Classification
backscatter values threshold based on ERS SAR imagery

Operational Support
ERS imagery used in navigation of MSC icebreakers

River Channel - Ob Estuary
Use of SAR images to find best routes for icebreakers

Sea Ice Type Classification
RADARSAT (Central Kara Sea)

The ARCDEV Exploratory Voyage (schematic view of convoy route)

High Resolution Winds
Velocity wind fields derived from ERS SAR images

Ocean Fronts and Jets
COASTWATCH 1996:
ERS-2 SAR image resolving ocean front features

Living Resources and Health of the Ocean Modules

In situ and SeaWIFS Mapping of a toxic Chatonella Bloom in west Danish waters

Monitoring Algae Blooms

In situ, Satellite and Modelled Phytoplankton Distribution (toxic *Chatonella* Bloom in west Danish waters)

Coastal Zone and Health of the Oceans Modules

Oil Slicks
ERS SAR image data from the North Sea

Ship Pollution Slicks
ERS SAR imagery (Baltic Sea)

ALL MODULES

Ocean Modelling and Data Assimilation
DIADEM - North Atlantic Data Assimilation System
prototype with 20 km resolution in North Atlantic
Model system is based on
MICOM (Miami isopycnal coordinate ocean model)
Fasham type biogeochemical model
Viscous plastic ice dynamics model
Data assimilation method
ensemble Kalman Filter (EnKF)

Observations
TOPEX & ERS sea level anomalies
AVHRR sea surface temperature
SeaWIFS ocean colour

Nested Ocean Models
Industrial applications
one way nesting
orthogonal curvilinear model grids
7-8 km intermediate model
2 km high resolution model

High Resolution Ocean Circulation

V.11.3 INSTITUTE OF MARINE RESEARCH (IMR)

Extracted from the IMR Environmental Observing System brochure

1. INTRODUCTION

IMR is a national centre placed under the Ministry of Fisheries for research on the marine living resources and the marine environment. The institute has about 500 employees of which 150 are scientists. In addition to the main facilities in Bergen, IMR has three research stations and five research vessels. The overall objectives of the institute are to provide the scientific basis for:

- Future-oriented and sustainable management of the marine environment
- Diverse and economic viable fisheries by ecologically responsible utilisation of the marine living resources.
- Diverse and viable aquaculture on a genetic and environmental safe base.

2. FIXED OCEANOGRAPHIC STATIONS AND SECTIONS

During the period 1935-1947 the IMR established a number of fixed oceanographic stations along the Norwegian coast between the Skagerrak and the Barents Sea. The main objective was to monitor the ocean climate variability in relation to fisheries. Temperature and salinity measurements were regularly taken on these fixed stations since the start with yearly observation frequency of 26-40. The work is carried out by local observers who today are equipped with modern instrumentation. Ocean Weather Station Mike in the Norwegian Sea has been operated by the University of Bergen since 1948. Since 1990 the IMR carried out weekly measurements of nutrients, chlorophyll and phytoplankton.

The systems of fixed oceanographic sections has been operated for about 20 years in the Norwegian and the Barents Seas and for about 30 years in the North Sea. Some of the sections have sporadically been observed since the turn of this century. Chemical parameters, such as nutrients and oxygen, as well as plankton have been observed on selected stations and sections during the last 10-20 years.

3. REGIONAL COVERAGES

In addition to the system of fixed oceanographic stations and sections IMR has regular regional monitoring of the conditions in the North Sea/Skagerrak, the Norwegian Sea, the Barents Sea and in the Norwegian coastal area. This activity is related to variability in ocean climate, plankton production, recruitment to fish stocks and anthropogenic impacts, such as input of nutrients and harmful algal blooms, organic contaminants and radioactivity.

4. THERMOGRAPHIC SERVICE

In 1936 the IMR established a system for recording temperature and salinity in the surface layer along the Norwegian coast by using commercial vessels. The route between Stavanger and the northernmost coast of Norway is surveyed twice a week. In the mid-fifties the program was extended to some shipping routes across the North Sea.

These routes were stopped in the early 1980s and today only the North Sea route between Stavanger and Aberdeen is covered once a week.

5. MONITORING THE FJORDS

In November - December each year the environmental conditions in the fjords along the western and northern coast of Norway are observed. Temperature, salinity, oxygen and nutrients are measured. These observations give information on long-term variations in the ocean climate and a possible negative development in the content of nutrients and oxygen as a consequence of eutrophication.

6. THE SKAGERRAK COASTAL CONDITIONS

At Flødevigen Research Station temperature and salinity are observed daily at several depths. These time series date back to 1924. Since 1985 there has been a regular monitoring for harmful algae and the results are reported weekly during the algae season. Since 1990 hydrographic, hydrochemical and biological parameters have been observed monthly at two locations off Arendal. In October each year the fjords of the Norwegian Skagerrak coast are monitored with respect to hydrographic and hydrochemical parameters as well as beach seine sampling for juvenile fish. These investigations started in 1920.

7. WHY DO LONG-TERM ENVIRONMENTAL MONITORING?

The world oceans play a major role in a large number of processes occurring at the surface of the earth. These processes influence the human environment and are in turn influenced by human pressure. The global climate seems to be in a process of change which could be caused by anthropogenic influence. Superimposed on this possible global changes are the large natural fluctuations.

In our waters there is a close relationship between the marine environmental variability and the fish stocks. Ocean climate fluctuations influence distribution, recruitment and growth of fish stocks. Long-term observation series combined with studies on the driving forces of the climate variability are necessary to predict the climate and thereby improve the management of the fisheries.

Significant amounts of contaminants have the ocean as their final destination. Monitoring the contaminant level is important both as an early warning of possible ecological damage and to observe the effect of introduced measures to reduce the pollution.

All nations have international obligation to monitor their marine waters and thereby contribute to the Global Ocean Observing System (GOOS). GOOS is conceived as a new, internationally organised system for gathering and distribution of marine data and derived products. It is envisioned to resemble the global meteorological observations and prediction network. The GOOS data and products will be applied for the benefit of mankind and for the safe use and preservation of the marine environment.

V.12 RUSSIAN FEDERATION

In 1998 the National Oceanographic Committee of the Russian Federation (NOC RF) established a national Working Group on GOOS. Its goal is to prepare the national GOOS program and proposals on the participation of Russian institutions in various projects related to GOOS activities.

The composition and Terms of reference of the Working Group are given in the Annex to this report.

The following national agencies and institutions participate in various areas of GOOS activities:

The Russian Academy of Sciences (RAS)
1. P.P. Shirshov Institute of Oceanology
2. Southern Branch of P.P. Shirshov Institute of Oceanology
3. Pacific Oceanological Institute, Far-Eastern Branch of RAS
4. Institute of Global Climate and Ecology (RAS and Roshydromet)

Federal Service of Russia for Hydrometeorology and Environmental Monitoring (Roshydromet)
5. Hydrometeorological Centre of Russia (a State Scientific Centre of Russia)
6. All-Russian Research Institute of Hydrometeorological Information -World Data Centre (RIHMI-WDC)
7. The State Oceanographic Institute
8. St.-Petersburg Branch of the State Oceanographic Institute
9. Far-Eastern Regional Hydrometeorological Institute
10. Arctic and Antarctic Research Institute (a State Scientific Centre of Russia)

Department of Navigation and Oceanography, Ministry of Defense
11. Oceanographic Research Centre of the State Navigation & Hydrography Research Institute
12. Hydrometeorological Service of the Navy
13. N.N. Andreyev Acoustics institute (a State Scientific Centre of Russia).

In 1998 NOC RF created a web-site "Russian Marine Research" containing information on national marine research programs and various aspects of participation of Russia in major international programs such as GOOS. The English version of the web-site is located at (http://www.extech.msk.su/english/ocean/index.htm).

In 1998 the Government of the Russian Federation adopted a new long-term federal program "World Ocean". It will be the main program coordinating all national marine activities up to the year 2012. The program consists of ten sub-programs. Two of them namely "Study of the Nature of the World Ocean" supervised by the Ministry of Science and Technologies of the Russian Federation and "Creation of the unified information system on the state of the World Ocean" supervised by the Roshydromet include tasks aimed at development of modern systems for ocean data acquisition and oceanographic data/information exchange. Both sub-programs are of direct relevance to GOOS. The other eight sub-programs also contain numerous elements, which are of importance for all five modules of GOOS.

Within the frame of the federal program "World Ocean" and under the leadership of the Institute of Oceanology several research institutions have initiated a research program called "Acoustic Thermometry of Ocean Climate" (ATOC). The program is aimed at developing an acoustic system for monitoring the climate variability of the Arctic Ocean, acoustic monitoring of water and heat exchange through the Fram Strait and integrated monitoring of the Bering Strait. The research work under this program will further promote the study of global climate change. It will contribute to the climatic module of GOOS as well as to

such research programs as CLIVAR and ACSYS. Development of the autonomous system for acoustical monitoring of the Arctic Ocean and long-term monitoring of the area along the Hawaii-Kamchatka traverse is the main objective of the project ATOC being implemented jointly by Russia and USA.

The Institute of Oceanology also conducts a research program "Monitoring of the ocean-atmosphere interaction". It is focused on the climate change forecasting and the program objectives are of direct relevance to CLIVAR and GOOS. At present a Working Group on CLIVAR develops a co-ordinated national CLIVAR program.

RAS, Roshydromet, and the Russian Space Agency (RSA) approved the concept of a national program on development of space-based observations of the oceans. The program will be implemented in 1996-2015. Its basic idea is to create a system of specialized satellites for oceanographic research. Several institutes of the RAS, Roshydromet, and RSA participate in this program. The program leader is the P.P. Shirshov Institute of Oceanology.

The Arctic and Antarctic Research Institute (AARI) continues to carry out the integrated environmental studies of the northern and southern polar areas and provides operational hydro-meteorological services to shipping and economic activities in the Arctic and Antarctic. Within the EuroGOOS activities the AARI plans to ensure operational exchange of hydro-meteorological and sea-ice information for the Arctic seas of Europe. Information to be provided by AARI will be available on the WWW server (at http://www.aari.nw.ru). On July 19-23, 1999, the AARI hosts the First Transition Planning Meeting of the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology, which is expected to be the major vehicle supporting the development of operational oceanography.

The automated sea-ice information system for the Arctic (ALISA) developed at the AARII continues to be improved. The AARI is a leading institute of the research project "Development of the basis for the GOOS module on operational marine meteorological and oceanographic services", which is a part of the Roshydromet research program.

The Hydrometeorological Centre of Russia fulfills duties of the World Meteorological Centre “MOSCOW" of the WMO. In addition to a wide range of weather forecasts the centre prepares and disseminates marine meteorological analyses and forecasts. Their list includes wind wave forecasts over the North Atlantic and non-arctic seas of Russia, global data on SST distribution, ice conditions and storm surge predictions for the non-arctic seas, long-term forecasts of the Caspian sea-level, ship routing services. The research at HMC Russia is aimed at further improvement of international hydro-meteorological monitoring and forecasting and is of particular relevance to the GOOS marine meteorological and oceanographic services module.

The State Oceanographic Institute (SOI) and its St.-Petersburg Branch conduct monitoring of the Baltic Sea within the framework of the HELCOM. They participate in a regular assessment of the state of the Baltic Sea. The St. Petersburg Branch of the SOI jointly with the North - Western Regional Branch of the Roshydromet prepared a proposal on information exchange with the Swedish Meteorological and Hydrological Institute. Its purpose is to develop a regional operational forecasting system based on a high resolution oceanographic model.

Within the framework of the IOC Black Sea Regional Committee actions have been taken to plan and develop a Regional Black Sea GOOS project. The State Oceanographic Institute presented at the 2nd session of the IOC Regional Black Sea Committee (Istanbul, May 1999) its proposals on the development of GOOS regional activities related to the Health of the Ocean and Coastal modules of GOOS. In 1997-1998 the Hydrometeorological Centre of Russia in cooperation with the Institute of Meteorology and Hydrology of Bulgaria and Meteo-France formulated a proposal on the development of a modern regional operational marine services system in the Black Sea (BLACKMARS). At the 2nd session of the GOOS LMR Panel (Montpelier, France, March 1999) the Institute of Oceanology presented a report on the environmental changes of the Black Sea during the last 20 years under the influence of

anthropogenic factors. The report also described the status and results of monitoring of living marine resources conducted by the institute during the last decade.

The Chief Department of Navigation and Oceanography of the Ministry of Defense prepares various manuals and guides needed for shipping including electronic marine charts, electronic sailing directions, and notices to mariners as well as ocean atlases which are of particular importance for the GOOS operational services and climate modules.

The Pacific Oceanological Institute and the Far-Eastern Hydrometeorological Research Institute participate in the NEAR-GOOS project.

With regard to further development of GOOS the priorities of Russia are determined by the above mentioned national programs and activities, which have received approval and support by the Government. The following activities are considered high priority:

- Development of ocean monitoring system required for climate change forecasting (as a part of the GOOS climate module).
- Development of methodology and technology for coastal area monitoring (as a part of the GOOS coastal module).

- Development of the operational marine meteorological and oceanographic services module of GOOS.
- Participation in GOOS regional pilot projects, particularly, NEAR-GOOS and the Black Sea GOOS.
- Development of GOOS regional pilot project for the Baltic Sea and the Arctic Seas in cooperation with EuroGOOS.
- Further participation in operations of existing ocean observing systems such as IGOSS, GLOSS, and VOS of WMO.
- Development of space-based ocean observing systems, acoustical and buoy technologies for ocean monitoring.
- Preparation of oceanographic climatic atlases, charts and guides for shipping.
- Improvement of the system for oceanographic data/information exchange.

Annex to the Report of the Russian Federation

**National Oceanographic Committee of the Russian Federation (NOC/RF)
Working Group of the NOC/RF on the Global Ocean Observing System
(WG/GOOS)**

The WG/GOOS was established by the National Oceanographic Committee on the 18th June 1998 to co-ordinate national GOOS activities, and, in particular, to:

(1) review the development of GOOS;
(2) carry out analyses and make proposals on participation of national institutions in the regional and global GOOS projects;
(3) make proposals on the improvement of the existing ocean observing systems and related data management activities and their integration into GOOS;
(4) review the activities within other global observing systems, GCOS and GTOS in particular, in order to ensure their proper co-ordination with GOOS; and
(5) prepare national GOOS program and plan as a component of relevant sub-programs of the federal program "World Ocean".

Composition of the Group:

Lappo S.S., Institute of Oceanology, RAS - Co-Chairman, Moscow
Ryabinin V.E., Hydrometeorological Centre - Co-chairman, Moscow
Akoulichev V.A., Pacific Oceanological Institute, Vladivostok
Bobkov S.A., Hydrometeorological Service, Department of Navigation and Oceanography of the Ministry of Defense, Saint-Petersburg
Viktorov S.V., State Oceanographic Institute, St.-Petersburg Branch, Saint-Petersburg
Vasilyev A.S., State Oceanographic Institute, Moscow
Danilov A.I., Arctic and Antarctic Research Institute, Saint-Petersburg
Zilberstein O.I., State Oceanographic Institute, Moscow
Tsyban A.V., Institute of Global Climate and Ecology, Moscow
Shiganova T.A., Institute of Oceanology, Moscow
Kosyan R.D., Institute of Oceanology, Southern Branch, Gelenzhik
Krivosheya V.G., Institute of Oceanology, Southern Branch, Gelenzhik
Kontar E.A., Institute of Oceanology, Moscow
Lavrenov I.V., Arctic and Antarctic Research Institute, Saint-Petersburg
Lapshin V.B., State Oceanographic Institute, Moscow
Martishthenko V.A., Roshydromet, Moscow
Mikhailov N.N., National Oceanographic Data Centre (RHHMI-WDC), Obninsk
Nesterov N.A., Department of Navigation and Oceanography, Ministry of Defense, Saint-Petersburg
Oradovskiy S.G., State Oceanographic Institute, Moscow
Priymak G.I., Acoustic Institute, Moscow
Pelevin V.N., Institute of Oceanology, Moscow
Tkalin A.V., Far-Eastern Hydrometeorological Research Institute, Vladivostok
Turovtsev O.N., State Navigation & Hydrography Research Centre, Ministry of Defense, Saint-Petersburg
Tolkatchev A.Ya., National Oceanographic Committee, Moscow
Utyakov L.P., Institute of Oceanology, Moscow

V.13 SEYCHELLES

Extract from letter to Executive Secretary IOC from Director-General, International Relations Division, Ministry of Foreign Affairs (21.6.1999)

Subject: Initial GOOS Commitments Meeting

I regret to inform you that Seychelles will not be able to participate in the meeting but we would however like to communicate to you our commitments and intention to implement the GOOS.

National Contribution to GOOS

a) Living Resources module

Monitoring and assessment of the coastal and oceanic living resources of the Seychelles Economic Exclusive Zone (EEZ). The Seychelles Fishing Authority has an extensive database (1983-date) on marine ecosystem mainly biological parameters and to a lesser extent physical and chemical. It is our intention to move towards the two latter parameters in the near future.

b) Services Module – Information and Data Management (Oceans)

The Seychelles Fishing Authority (SFA) as the Designated Oceanography Data Agency is committed to capture and process information about Oceans and convert into procedures required by users in Seychelles. The SFA is also involved in the services such as support for fisheries research and development, Coastal Management and improving the safety of life at sea.

The SFA is also participating in the Intergovernmental Oceanographic Commission Project ODINAFRICA for Data and Information Management.

With the support of the IOC, we wish to indicate our intention to become more active in the GOOS Program.

V.14 SPAIN

Spain shares the great interest of the international community in the matters and issues related to GOOS objectives. Spain welcomes the establishment of GOOS and expects to join her effort to its progress and development.

Several Spanish agencies include among their activities systematic and routine observation programs that can be considered under the heading of operational oceanography. Some of these institutions, in particular Instituto Español de Oceanografía (IEO) and Puertos del Estado (PE), are working together with the goal of reaching an agreement to pool their resources and to combine interests in particular areas of observation, setting up the foundation of a future national oceanic service. Among its future plans is the accepting of a data policy which will make data available according to the GOOS principles and plans.

One of the priority lines of research of IEO is the study of temporal variability and trends in oceanographic conditions and biological communities in specific sites through the long term and systematic monitoring of several variables to understand the underlying causes of temporal variability of the physical and biological properties and processes in the pelagic ecosystem in the neritic and oceanic waters surrounding the Spanish coast. Its scientific objectives are integrated in the framework of GLOBEC and JGOFS. The research effort involves time series in several transects along the Spanish coast, on both the Atlantic and the Mediterranean sides, sampled according to JGOFS recommendations at monthly intervals, and synoptic observations by satellite imagery.

IEO, Instituto Canario de Ciencias Marinas, the Marine Physics group from the Institut für Meereskunde in Kiel and the JGOFS group of the University of Bremen have, in the early 90s, established jointly the so called European Station for Time Series in the Ocean Canary Islands (ESTOC). It is located 60 miles north of the island of Gran Canaria in waters some 3000 m deep and it is visited every month. The station is in an eastern boundary regime and it is a very appropriate complement to the Bermuda stations.

IEO has a research program related to the prediction and monitoring of harmful alga blooms and it is also involved in several European Commission proposals, PHILTER and EUPHYTONET, related to the same issue.

There are three tide gauge networks in Spain in the charge of IEO, Instituto Geografico Nacional and (PE); each one responsible for its own network. They add up to 24 stations, some with more than one gauge, distributed along the Spanish Mediterranean and Atlantic coast as well as in the archipelagos. Some of the stations started gathering data from the end of the XIX century although the main bulk of information has been registered from the mid-forties. Data can be obtained in real time at ten stations. Three of the stations belong to the GLOSS network. Information is also sent to international tidal centres. Spain is a member of COST Action 40 European Sea level Observing System (EOSS). The above mentioned three institutions plus Instituto Hidrografico de la Marina are collaborating in a national project, RIMA, to integrate the networks and to create a common Spanish sea level data bank. Presently, institutions are publishing an annual volume with astronomical prediction, mean and extreme sea level, tidal ranges, etc. Data is provided to users on personal request. It is expected to set up a web system through which information can be requested and distributed.

A wave forecasting system developed to predict waves at the coast is run on a twice a day cycle by Clima Maritimo (CM), a group of PE. This system is based on two wave generation models: the WAM model and the WAVEWATCH model. The system is designed to provide a wave forecast with 72 hours of lead time to the Spanish harbours in the Atlantic and in the Mediterranean coast.

CM is running also a storm surge forecasting system developed to predict sea levels at the coast. It runs on a twice a day cycle. The system is based on runs from a 3-D hydrodynamical model (HAMSOM) and data assimilation of tidal levels recorded by the tidal gauge network from PE. The model runs are carried out on a computational mesh set around

Spanish waters and is forced by meteorological fields provided by the atmospheric forecasting model HIRLAM from the Spanish Instituto Nacional de Meteorologia. The system is designed to provide a sea-level forecast with 48 hours of lead time to the Spanish harbours in the Atlantic and in the Mediterranean coast.

PE and Centro de Estudios y Experimentacion de Obras Publicas (CEDEX) maintain, since the early eighties, a full operational wave buoy network. It consists of nineteen scalar buoys and three directional ones that transmit data in real time via radio to shore stations.

PE began ten years ago to work on the development of wave remote measuring techniques based on navigational radar that culminated by installing two experimental stations on the north Iberian coast and in the Canary Islands.

In 1996 PE launched a marine monitoring project: RAYO (Red de Alerta y Observacion), intended to set-up a permanent observing system of surface waters around the Spanish coast. The core of the system consists of nine ocean-meteorological buoys, moored in the vicinity of the shelf-break in depths ranging from to 250 m up to 900 m in the Atlantic waters of the Iberian Peninsula and the Canary Islands. These buoys transmit recorded data on an hourly basis via satellite to the Control Centre at Madrid. The multisensor buoys register meteorological parameters (wind, pressure, and temperature) and surface oceanographic parameters (wave, current, temperature and conductivity). Three of the buoys also carry a CTD chain. Also three independently moored current meters lines have been installed, with the co-operation of the IEO, in the vicinity of some buoys. The project has increased the existing coastal sampling coverage by installing three land based wave radar stations and three wave directional buoys. An objective of the project has been to emphasise quasi real time transmission and final user's data delivery by installing a dedicated communication link between the Control Centre and the main users (Port Authorities) and developing a web page where other institutional bodies and third parties can get these data. By-products derived from real time transmitting deep water buoys have been developed such as on-line verification of current wave model forecast and a coastal wave nowcast based on the propagation of the directional spectrum transmitted by the buoys.

In spite of the growing interest about operational oceanography that there is in Spain, there is, at present, no common national program. Activities related to operational oceanography are carried out by independent agencies. The basic establishment of such a service as GOOS proposes will be reached through the conjunction of the efforts and infrastructure of those agencies under a sort of consortium that serves as foundation of a more ambitious and specific national program. As said above several agencies are working on this line of cooperation.

The enhancement of a marine observing network of national character can be carried out by statements and promotion by the corresponding GOOS bodies in those intergovernmental and international fora which are linked to the different GOOS modules.

V.15 UNITED KINGDOM

The UK Government supports the development of GOOS and participates actively in both GOOS and EuroGOOS.

A wide range of UK Government Departments, Agencies, and Industry undertakes marine observations and their applications. General discussions of the UK input to GOOS (and all marine-related observing programs) take place within the Government's Inter-Agency Committee on Marine Science and Technology. There is a cross-Government GOOS Action Group, chaired by Dr Howard Cattle, Meteorological Office, assisted by Dr John Portmann as Co-ordinator, which includes industrial representation.

An inventory of marine-related observations can be reached through the IACMST Web Site (www.marine.gov.uk), which also points to sources of available data and other general UK marine information. The inventory of observations is being updated at present with support from the Meteorological Office and the Department of the Environment, Transport and the Regions. The same review is also seeking to establish a general rationale within which the diversity of observing programs can be developed.

In preparation for the GOOS Commitments Meeting, the Inter-Agency Committee on Marine Science and Technology has written to all the principal public sector organisations which are known to have an interest in marine observing programs. They were all asked: "Is your organisation prepared to agree in principle that the data from existing observation programs can be regarded as potential contributors to GOOS?"

Agreement in principle has been received from all organisations approached. In some cases organisations have a reserved position on the use of data for commercial purposes. A short summary of these organisations follows.

The Environment Agency of England and Wales which has a number of regulatory responsibilities, including those relating to the coastal zone. It supports these responsibilities with a large coastal monitoring program. This includes airborne surveys using LIDAR of the vulnerability of low-lying coastal areas to flooding and sea level rise due to climate change.

The Meteorological Office which also operates flood warning and ship routing services. The Met Office operates an offshore array of fixed buoys supplying observations mostly from sea areas to the west of the UK.

The Scottish Office, which includes the Fisheries Research Services. Long-term hydrographic monitoring of the waters around Scotland is undertaken. A very large part of the UK fishing and oil and gas industries are centred in Scotland.

The Northern Ireland Office which has responsibility for monitoring coastal waters around Northern Ireland.

The Ministry of Agriculture, Fisheries and Food Centre for Environment, Fisheries and Aquaculture Science (CEFAS). Programs include monitoring the quality of the marine environment in and near sites of industrial disposal and a wide range of studies relating to fish and levels of fish stocks. There is an increasing interest in the marine environment including its importance in the farming of fish and shellfish.

The Natural Environment Research Council *The Centre for Coastal and Marine Sciences* operates laboratories in Plymouth, Merseyside (the Proudman Oceanographic Laboratory) and Oban (Dunstaffnage). The *Southampton Oceanography Centre* has a wide range of coastal and global ocean observing programs, including developing products from satellite information. Both have agreed in principle to making their data available.

The Joint Nature Conservation Committee has a Program of mapping seabed communities of mainly inshore waters, including the development of new procedures and techniques.

The Sir Alister Hardy Foundation for Ocean Science, which operates the continuous plankton recorder survey, has asked its sponsoring organisations to allow their data to be available within GOOS.

Support for the GOOS Project Office

In addition to supporting the GOOS Project Office through UNESCO's core support for the IOC, the UK NERC will contribute £12,000 per annum for three years starting in 2000, particularly to help the biological aspects of GOOS to develop. The long standing $10,000 per annum UK support for the GLOSS Program within GOOS will continue for the immediate future.

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V.16 UNITED STATES OF AMERICA

1. INTRODUCTION

The U.S. has advocated a Global Ocean Observing System for a number of years and has contributed substantially to its planning. Conceptually it has supported planning for GOOS according to the five established modules (which have subsequently been consolidated to four). Implementation of U.S. contributions to GOOS is primarily based on 1) global scale observations, and 2) coastal scale observations. These observations are characterized as "operational" in that they are intended to be financed for a long term and are done primarily to meet needs other than research.

2. GLOBAL SCALE ACTIVITIES

Present global-scale elements include:

- ENSO Observing System
- Meteorological observations and XBT measurements from Voluntary Observing Ships
- Drifting buoys
- Sea level measurements
- Operational satellites for sea surface temperature data

Pilot activities include:

- PIRATA
- Global Ocean Data Assimilation Experiment
- Argo Network of Profiling Floats
- Satellite-derived surface topography, vector winds, sea surface temperature, and ocean colour
- GOOS Data Center (at NOAA's Lab in Miami, Florida)
- HOT and BATS moorings (Hawaii and Bermuda)

Future plans may include:

- Global Eulerian Observatories
- CLIVAR basin-scale studies
- NPOESS
- Satellite gravity and salinity

3. COASTAL SCALE ACTIVITIES

Present coastal-scale elements include:

- Sea level, tsunami warning, and physical oceanographic real-time systems in ports
- Mussel Watch
- Fisheries stock assessments

Pilot activities include:

- Coastal buoys and fixed stations
- Coastal change analysis program
- Coral reef monitoring
- South Florida Ecosystem Restoration
- Chesapeake Bay Program
- Gulf of Maine
- CALCOFI
- GLOBEC

Future plans under consideration include:

- Coastal index sites
- Long-term ecological research sites

- Lab Net information system
- Sea floor observatories
- Observations by yachtsman, organized via the International Seakeepers Society

4. COMMENT

In the past five years the U.S. has given increasing attention to ocean issues and to the need to understand the role of the ocean in the global environment. In 1996 the U.S. initiated its planning for the 1998 Year of the Ocean. In 1997 legislation was enacted to create a National Oceanographic Partnership Program, and a U.S. GOOS Steering Committee was established. In 1998 the President and Vice-President hosted a National Ocean conference and announced a number of initiatives. A Congressional hearing on ocean observations was also held. Since then, planning has accelerated for implementation of many of the activities listed above, and it is fully expected that the momentum for GOOS will continue.

V.17 EUMETSAT

EUMETSAT's operational activities are making a direct contribution to GOOS.

According to the Initial Convention:

"The primary objective ... is to establish, maintain and exploit European systems of operational meteorological satellites...."

According to the New Convention:

"A further objective ... is to contribute to the operational monitoring of the climate and the detection of global climate change.."

EUMETSAT is an organisation of 17 member states in Europe. Its satellite program has three main elements: METEOSAT, MSG, AND EPS (METOP):

METEOSAT 5 runs to end 1999, and is planned through 2001;
METEOSAT 6 runs to end 2000, and could go through 2002;
METEOSAT 7 runs to end 2003, and could go through 2004.

METEOSAT Second Generation (MSG) 1, 2, and 3 are approved for starts in 2000 (to 2007), 2002 (to 2009), and 2006 (to 2012).

The EUMETSAT Polar System (EPS) program's METOP-1, 2, and 3 are approved for starts in 2003 (to 2008), 2007 (to 2012), and 2012 (to 2017).

The Meteosat Second Generation (MSG) includes an advanced SEVIRI imager with:

12 visible and infrared channels
15-minute imaging frequency
3 km ground resolution at nadir for 11 channels
1 km ground resolution for High Resolution Visible channel
GERB, Geostationary Earth Radiation Budget radiometer

The EUMETSAT Polar System (EPS) incorporates:

All weather/advanced operational temperature/moisture sounding
ATOVS, MHS, IASI, GRAS
Global visible/IR 1 km resolution imagery : AVHRR
Ocean Wind Vectors: ASCAT
Ozone monitoring : GOME-2 and follow-on instrument

Applications and their geographical distributions are as follows:

Function/Facility	**Site or host**
Meteorological Product Extraction Facility (MPEF)	EUMETSAT HQ (D)
Meteosat Archive and Retrieval Facility (MARF)	EUMETSAT HQ (D)
Multi-mission Unified Meteorological Archive and Retrieval Facility (U-MARF)	EUMETSAT HQ (D)
SAF on Support to Nowcasting and Very Short Term Forecasting	Madrid (E) (host)
SAF on Ocean and Sea Ice	Lannion (F) (host)
SAF on Ozone Monitoring	Helsinki (FIN) (host)
SAF on Climate Monitoring	Offenbach (D) (host)
SAF on Numerical Weather Prediction	Bracknell (UK) (host)
SAF on GRAS Meteorology	Copenhagen (DK) (host)
SAF on Land Surface Analysis	Lisbon (P) (host)

Meteosat Meteorological Products include the following operational products available in near real-time:

- Clear Sky Radiances
- Clear Sky Water Vapour Winds
- Climate Data Set
- Cloud Analysis
- Cloud Motion Winds
- Cloud Top Height
- High Resolution Visible Winds
- Sea Surface Temperatures
- Upper Tropospheric Humidity

All of the above are generated between 1 and 48 times each day on an operational basis. The Climate Data Set is stored for research use. The other products are distributed to users immediately after processing.

The SAF on Ocean and Sea Ice is hosted by Météo-France in Lannion. It involves France, The Netherlands, Sweden, Denmark, and Norway. Development began in April 1997. Targeted products include:

- Sea Surface Temperature (Atlantic): gridded (10 km), pattern analysis (2 km)
- Scatterometer surface wind vectors (global)
- Surface radiactive fluxes (Atlantic)
- Sea Ice (Polar Atlantic): ice edge/cover, thickness/age

The SAF on Climate Monitoring is hosted by the German NMS (DWD) in Offenbach. It involves Germany, Finland, Sweden, The Netherlands, and Belgium. Development began in February1999. Targeted products include:

- Sea Surface Temperature and sea ice cover
- Cloud parameters
- Surface radiation budget components
- Radiation budget components at TOA
- Vertical profiles of temperature and humidity

V.18 EuroGOOS

1. I refer to the EuroGOOS statement to I-GOOS IV (IOC-WMO-UNEP/I-GOOS-IV/10). That document, together with the EuroGOOS MoU in 1994, and the revised constitution of EuroGOOS which will come into force in January 2000, states that EuroGOOS works within, and is a component of GOOS. All observations, data management, modelling and ocean product delivery are conducted by the Member Agencies. EuroGOOS provides the mechanism for collaboration, analysis of common requirements, and voluntary collective action.

2. EuroGOOS as one of the regional components of GOOS needs to communicate efficiently with the GOOS Project Office, and with the other Regions of GOOS. This collaboration is based on three principles:

   i) The need for EuroGOOS to understand outer boundary conditions and adjacent ocean basins. This leads us to establish strong working relations with MedGOOS, GOOSAfrica, IOCaribe GOOS, and interest groups in the USA, Canada, and the South Atlantic.

   ii) Sharing professional experience and ideas on regional GOOS administration. This underpins our regular correspondence with NEARGOOS.

   iii) The need for EuroGOOS and the other regions to contribute logically and scientifically consistent observations, which will build up the global system.

3. EuroGOOS will support and assist GOOS-related development and operations in developing countries and regions through TEMA activities. We are concerned to provide assistance in the North African region, Caribbean, and South Atlantic in particular, and in Eastern Europe.

4. EuroGOOS consists of 30 Member agencies in 16 countries. The national and agency commitments will be made by their representatives at this meeting in most cases. I have been asked by the delegate for Spain to present their report, and I will summarise this later and present a copy of their report in writing.

5. EuroGOOS is driven by the need to extract useful information of socio-economic benefit from numerous regional and semi-enclosed seas. Europe is an urban industrial archipelago continent, and the adjacent seas are used intensively.

6. The various European countries therefore collaborate round each regional sea area, using numerical models to integrate the observations, and produce high-resolution simulations and forecasts. The regional sea groups are: Baltic, adjacent Arctic, Mediterranean, North West Shelf and Atlantic. We have a dialogue with Black Sea GOOS.

7. EuroGOOS Members are collectively responsible for several thousand coastal monitoring installations, buoy moorings, repeat coastal water quality sampling points, XBT and CTD sections, ADCP and other current measurements, drifting buoys, yo-yo buoys, CPR and chlorophyll fluorescence sections, and standard fish-stock monitoring. EuroGOOS, with the support of the EU-DGXII, is starting to create a complete GIS inventory of all these operational observations. This inventory will be used in future planning, and will be made available to the Coastal Module of GOOS. This inventory effectively defines the European initial observing system of GOOS within the region, excluding space ocean observing mission and European observations on a global scale.

8. EuroGOOS Members have collaborated to analyse customer requirements, data priorities, and the socio-economic benefits of GOOS more thoroughly than any one

country or agency could have done. These activities do have analogues in other regions, and we are happy to share the methodology if requested. Each GOOS Region is different, and techniques and priorities are not directly transferable.

9. EuroGOOS Members already operate over 50 different operational forecasting models, and we have co-ordinated our response to participation in the Global Ocean Data Assimilation experiment and ARGO. I have received the French documents on GYROSCOPE, which is now being developed.

10. We anticipate that by the year 2005 the space agencies and government funding sources will not be prepared to go on supporting routine observation of the ocean exclusively under the budget heading of scientific research. We are therefore working closely with EUMETSAT and ESA to develop a plan for operational satellite missions after 2005 designed specifically to provide the data needed by GOOS. This plan includes RS salinity measurement.

11. The European dimension is an important factor for scientific, environmental and institutional reasons. The EU has just launched its Framework 5 funding program for S&T investment for the next four years. This program includes numerous budget items for coastal ecosystem management, ocean forecasting, data assimilation, operational modelling, interfacing physical and ecological modelling, new ocean instrumentation, and ocean climate variability. EuroGOOS Members have put together many research and pre-operational projects, which are funded by the EU, and we hope to continue this success.

12. Joint activities ongoing now include a regional real-time data policy, installation of real time water quality monitoring on commercial ferries, standardisation of long-duration robotic instrumentation with anti-bio fouling characteristics, regional seas monitoring, and analysis of new data products.

13. We are holding a User Products meeting in Bergen in September 1999. Many EuroGOOS Members operate real-time data web sites, and these can all be accessed from a central web site at the EuroGOOS home page.

V.19 SAHFOS
(SIR ALISTER HARDY FOUNDATION FOR OCEAN SCIENCE)

STATEMENT ON SAHFOS PARTICIPATION IN THE GLOBAL OCEAN OBSERVING SYSTEM

SAHFOS is strongly committed to the aims of GOOS and hopes to take an active role in the development of future implementation strategies with a focus on Living Marine Resources. The Continuous Plankton Recorder Survey managed by SAHFOS is an existing long-running operational survey that was started in the North Sea in 1931. The survey has traditionally operated in north west European shelf seas, across the northern Atlantic and on routes down the eastern margin of North America. More recently routes have been operated in the Mediterranean and Baltic Seas and as part of a Large Marine Ecosystem study funded by UNIDO in the Gulf of Guinea.

The survey uses voluntary 'ships of opportunity' to tow a plankton sampling mechanism that has changed little in design over the last 50 years. As a result a large database has been compiled using standardised methodologies and consisting of the results from >200,000 samples and representing >4 million miles of ocean surveyed. Analyses of the results have demonstrated pronounced long-term trends and stepwise shifts in plankton over the last 50 years. Some of these changes reflect changing patterns of major atmospheric circulation (e.g. the North Atlantic Oscillation) and associated hydrographic changes (sea surface temperature and currents) and others provide evidence of effects from fisheries and possibly eutrophication. Overall CPR results are used as a baseline against which natural variability and anthropengic impacts, including effects of climate change can be assessed.

The operational products of the survey are generally not available in real time, but some months after sampling as the CPRs need to be returned to the laboratory, samples analysed under the microscope and appropriate quality control checks made before entry into the database. In most years analysis of the previous years samples (currently ~4000 samples per year) is completed by the end of April in the following year.

The data policy of SAHFOS fully complies with the developing data policy of GOOS. Access to data is free. A nominal charge to cover computing costs is levied for processed products that can be requested from the SAHFOS Data Manager. Data for phytoplankton colour and *Calanus finmarchicus* will be placed on the web in the near future and updated regularly. Persons wishing to utilize the raw data from the survey will need to visit SAHFOS to extract the information they need. This requirement is to ensure that the integrity of the database is maintained.

Increased emphasis has been placed on the need for long-term systematic observation on a global scale for the sustainable use and management of the oceans and seas of the world that comprise 70% of the surface of our planet. It is recognised that the CPR approach to monitoring is one of the few ways, in which the large spatial scales of the world's oceans can be sampled in a systematic, time and cost effective way. SAHFOS wishes to promote this approach and act as a centre of expertise and quality control for developing new programs. The organisation is already involved in helping to establish sister surveys in the Gulf of Guinea and Baltic Seas with plans for other surveys in the Pacific and Antarctic well advanced. Part of the role of the Foundation in this exercise is in a training capacity; a series of training workshops have already been held covering technical and plankton analysis skills.

Finally, the Foundation sees as an important part of its work technology development and research to pave the way for successor sampling systems to the CPR in the future. New towed bodies and sampling instrumentation are under development in partnership with commercial companies that will hopefully be of benefit to developing GOOS.

SAHFOS is an international charitable foundation based in Plymouth, UK. It is currently funded by a consortium that includes (MAFF, DETR, NERC) in the UK, (GOG)

UNIDO, (DFO) Canada, (Danish Institute for Fisheries Research) Denmark, (RIKZ, RIVM, RIVO-DLO, NWO) Netherlands, (NSF) USA, Inter-governmental Oceanographic Commission, European Union, Ireland, (IFREMER) France, (MRI) Iceland.

In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans S. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' ***(Also printed in Spanish)***
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping ***(Also printed in French and Spanish)***
12. Joint 100-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica lnternacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica ***(Spanish only)***
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources ***(Also printed in French and Spanish)***
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans ***(Also printed in French)***
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities ***(Also printed in Spanish)***
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CCPS Working Group on the Investigations of 'El Niño' (***Also printed in Spanish)***
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN(OALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic ***(Also printed in French)***
54. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico ***(Also printed in Spanish)***
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping

59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-Level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans ***(Also printed in French)***
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
71. ROPME-IOC Meeting of the Steering Committee on Oceanographic Co-operation in the ROPME Sea Area
72. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' ***(Spanish only)***
73. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico ***(Also printed** in **Spanish)***
74. UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
75. Third Session of the IODE Group of Experts on Marine Information Management
76. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
77. ROPME-IOC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
78. Third Session of the IOC Group of Experts on the Global Sea-level Observing System
79. Third Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
80. Fourteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
81. Fifth Joint IOG-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
82. Second Meeting of the UNEP-IOC-ASPEI Global Task Team on the Implications of climate Change on Coral Reefs
83. Seventh Session of the JSC Ocean Observing System Development Panel
84. Fourth Session of the IODE Group of Experts on Marine Information Management
85. Sixth Session of the IOC Editorial Board for the International Bathymetric chart of the Mediterranean and its Geological/Geophysical Series
86. Fourth Session of the Joint IOC-JGOFS Panel on Carbon Dioxide
87. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Pacific
88. Eighth Session of the JSC Ocean Observing System Development Panel
89. Ninth Session of the JSC Ocean Observing System Development Panel
90. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
91. First Session of the IOC-FAO Group of Experts on OSLR for the IOCINCWIO Region
92. Fifth Session of the Joint IOC-JGOFS CO, Advisory Panel Meeting
93. Tenth Session of the JSC Ocean Observing System Development Panel
94. First Session of the Joint CMM-IGOSS-IODE Sub-group on Ocean Satellites and Remote Sensing
95. Third Session of the IOC Editorial Board for the International Chart of the Western Indian Ocean
96. Fourth Session of the IOC Group of Experts on the Global Sea Level Observing System
97. Joint Meeting of GEMSI and GEEP Core Groups
98. First Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
99. Second International Meeting of Scientific and Technical Experts on Climate Change and the Oceans
100. First Meeting of the Officers of the Editorial Board for the International Bathymetric Chart of the Western Pacific
101. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
102. Second Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
103. Fifteenth Session of the Joint IOC-IHO Committee for the General Bathymetric Chart of the Oceans
104. Fifth Session of the IOC Consultative Group on Ocean Mapping
105. Fifth Session of the IODE Group of Experts on Marine Information Management
106. IOC-NOAA *Ad hoc* Consultation on Marine Biodiversity
107. Sixth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
108. Third Session of the Health of the Oceans (HOTO) Panel of the Joint Scientific and Technical Committee for GLOSS
109. Second Session of the Strategy Subcommittee (SSC) of the IOC-WMO-UNEP Intergovernmental Committee for the Global Ocean Observing System
110. Third Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
111. First Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate
112. Sixth Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting
113. First Meeting of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS)
114. Eighth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of "El Niño" ***(Spanish only)***
116. Second Session of the IOC Editorial Board of the International Bathymetric Chart of the Central Eastern Atlantic ***(Also printed** in **French)***
116. Tenth Session of the Off ices Committee for the Joint IOC-IHO General Bathymetric Chart of the Oceans (GEBCO), USA, 1996
117. IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Fifth Session, USA, 1997
118. Joint Scientific Technical Committee for Global Ocean Observing System (J-GOOS), Fourth Session, USA, 1997
199 First Session of the Joint 100-WMO IGOSS Ship-of-Opportunity Programme Implementation Panel, South Africa, 1997
120. Report of Ocean Climate Time-Series Workshop, Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate, USA, 1997
121. IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional Global Ocean Observing System (NEAR-GOOS), Second Session, Thailand, 1997

122. First Session of the IOC-IUCN-NOAA *Ad hoc* Consultative Meeting on Large Marine Ecosystems (LME), France, 1997

123. Second Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), South Africa, 1997

124. Sixth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico, Colombia, 1996 ***(also printed in Spanish)***

125. Seventh Session of the IODE Group of Experts on Technical Aspects of Data Exchange, Ireland, 1997

126. IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), First Session, France, 1997

127. Second Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 1998

128. Sixth Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1997

129. Sixth Session of the Tropical Atmosphere - Ocean Array (TAO) Implementation Panel, United Kingdom, 1997

130. First Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 1998

131. Fourth Session of the Health of the Oceans (HOTO) Panel of the Global Ocean Observing System (GOOS), Singapore, 1997

132. Sixteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), United Kingdom, 1997

133. First Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1998

134. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IOC/EB-IBCWIO-IW3), South Africa, 1997

135. Third Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), France, 1998

136. Seventh Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting, Germany, 1997

137. Implementation of Global Ocean Observations for GOOS/GCOS, First Session, Australia, 1998

138. Implementation of Global Ocean Observations for GOOS/GCOS, Second Session, France, 1998

139. Second Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Brazil, 1998

140. Third Session of IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), China, 1998

141. Ninth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Ecuador, 1998 ***(Spanish only)***

142. Seventh Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Croatia, 1998

143. Seventh Session of the Tropical Atmosphere-Ocean Array (TAO) Implementation Panel, Abidjan, Côte d'Ivoire, 1998

144. Sixth Session of the IODE Group of Experts on Marine Information Management (GEMIM), USA, 1999

145. Second Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), China, 1999

146. Third Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Ghana, 1999

147. Fourth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC); Fourth Session of the WCRP CLIVAR Upper Ocean Panel (UOP); Special Joint Session of OOPC and UOP, USA, 1999

148. Second Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1999

149. Eighth Session of the Joint IOC-JGOFS CO2 Advisory Panel Meeting, Japan, 1999

150. Fourth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Japan, 1999

151. Seventh Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1999

152. Sixth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 1999

153. Seventeenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), Canada, 1999

154. Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y el Golfo de Mexico (IBCCA), Septima Reunión, Mexico, 1998

IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IBCCA), Seventh Session, Mexico, 1998

155. Initial Global Ocean Observing System (GOOS) Commitments Meeting, IOC-WMO-UNEP-ICSU/Impl-III/3, France, 1999