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Reports of Meetings of Experts and Equivalent Bodies

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1. OPENING

Otis Brown, Chairman of J-GOOS, opened the Meeting at 09:00, 23 April 1996. The meeting was hosted by ICSU, in Paris. Brown welcomed the members and guests and then invited the sponsors present to address the meeting (the WMO representative was not scheduled to appear until the following day). The list of participants is contained in Annex II.

Gunnar Kullenberg welcomed the Committee on behalf of the IOC and wished them a productive meeting. He stressed the importance of the leadership that J-GOOS can provide to the GOOS effort. He stated that GOOS is in a critical phase now where it needs more momentum. A clear signal of progress is needed to enlist those nations that are sitting on the fence, and whose participation is central to the success of GOOS. Kullenberg informed the Committee that the position of Director of the GOOS support Office is currently being advertised at the D-1 level; closing will be mid-June. UNESCO administrative procedures would consume several more months before the position could be filled and an individual actually in place. Kullenberg emphasized that IOC is committed to GOOS and that he is trying to encourage "team" work on GOOS. The question of resources requires "pragmatic understanding". Will forecast resources really appear? The budgetary problems of the sponsors as well as of the nations must be taken into account.

Julia Marton-Lefevre welcomed the Committee to ICSU. ICSU is keenly interested in development of the observing system. GOOS is a novel experiment in cooperation between the IGO community and NGOs. The fiscal problems of IGOs are well known; the partnership is an interesting way ahead for international cooperation. ICSU supports research programmes of interest to GOOS, IGBP, WCRP, and just recently added the International Human Dimensions Program (IHDP). ICSU is also fostering development of the other two operational observing systems (GCOS and GTOS), and has SCOR and SCOPE in its family as well.

2. ADOPTION OF THE AGENDA

Brown invited discussion on the provisional annotated agenda. After modification to accommodate suggested changes, the Committee adopted the agenda (Annex I).

3. ADMINISTRATIVE MATTERS

3.1 GOOS ON THE WORLD WIDE WEB

Jean-Paul Rebert, Director of the GOOS Support Office, introduced the architecture of the GOOS information server implemented on the UNESCO World Wide Web (WWW) server:

http://www.unesco.org/ioc/goos/IOCGOOS.HTML

Rebert expressed his views on the responsibilities that might be taken by the different participants to GOOS concerning future developments. The purpose is manifold; it is designed to:

(i) Promote GOOS, have a public educational function, and in general serve to increase awareness of GOOS. To be effective it must be attractive and well designed. ICSU could play a leading role in finding talent to help develop this part if it is considered as important.

(ii) Provide GOOS "Handbook information" (e.. g., the structure of all GOOS bodies) to facilitate communication between GOOS players. The chairman of all the scientific Panels may find in their groups some member/institute willing to provide further information about the progress of their activities.

(iii) Provide information on GOOS events (meetings) and progress of existing observing systems (TAO, XBT, etc.) and bodies (IGOSS, GLOSS, DBCP), as well as information on national and regional programmes. The responsible bodies of these observing systems should be in charge of the developments and continuous updates of this part if it is to be continued.

(iv) Serve as an entrance point to the future network of data-and-products server as envisioned in the GCOS Data and Information Management Plan.

(v) Provide a comprehensive list of GOOS documents and reports with direct on-line access. An electronic version of all the reports should be systematically available to the GOOS Support Office.

(vi) Provide links to participating nations that have their own home page that can be easily linked to a national GOOS server.

(vii) Provide links to all GOOS related sites.

Rebert invited J-GOOS members to critically review the GOOS material on the WWW and to get back to him with any comments or suggestions they might have.

The Committee agreed on the concept and considered it as a useful tool to increase GOOS visibility and to more clearly delineate what one may consider to be (or not be) part of GOOS. The Committee recommended that the EuroGOOS server, though a little different in scope, and the GOOS server be correctly linked, highlighting the existence of national steering groups in each country, while ensuring consistency of national information between these two servers. The Committee agreed that, in order to protect the GOOS Support Office from an excessive workload for maintaining updated information, this maintenance system should be widely distributed, and individual and national responsibilities should be clearly sought and established.

3.2 J-GOOS BUDGET

Marten-Lefevre reviewed the J-GOOS budget document provided for the meeting (Annex III). She explained that staff support is not included in this budget - it is provided by the sponsors at no cost. Brown added that staff has been the limiting factor in the past year. At the moment, matters are totally *ad hoc* (e. g., SCOR had to be requested to staff the LMR Workshop). Some activities had to be curtailed or postponed. He stressed that the GOOS Office at IOC must be expanded if greater momentum is to be realized.

The Committee thanked the sponsors for the present arrangements and reiterated the important role of a secretariat in providing continuous, stable, support for GOOS. They strongly welcomed the UNESCO/IOC intention to appoint a Director at D-1 level to head the GOOS Support Office. The Committee also welcomed J. Marten-Lefevre’s assurance that all of the sponsors would be involved in the selection process. It was noted that although the office secretariat was supported by seconded national experts, the complexity of GOOS presented difficulties in ensuring continuity of attention by secretariat staff with fractional appointments.

The Committee then reviewed the proposed budget and moved to approve it in principle. It was recognized that funds and personnel resources available were insufficient to move ahead with despatch in the scientific design of GOOS and that the sponsors should be encouraged to seek additional support. The Committee requested that in future, the budget document include the uncharged man-months of effort contributed by the sponsors (and other agencies) toward approved J-GOOS activities. In addition, it was agreed that any decision for action by J-GOOS would include a clear indication of the staff support for it.

Subsequent to the discussions later in the agenda covering the status and proposed actions of the J-GOOS Panels for the GOOS modules, it was realized that the process and timing for budget approval by J-GOOS should be changed. Accordingly, Panel chairs were requested to submit budget estimates for 1997 by 1 June 1996 and preliminary budgets for 1998 by 1 December 1996 to the Chairman and the secretariat. This would provide an earlier alert to the sponsors for 1997 and be in time for both years to be considered at J-GOOS-IV. Decisions on budget items would be made towards the end of the meeting after the relevant discussions were concluded.

4. REGIONAL AND NATIONAL OUTLOOKS

4.1 EUROGOOS

N. Flemming reported on developments in EuroGOOS. EuroGOOS is a regional association of 22 national agencies from 14 European countries who are engaged in promoting and implementing operational oceanography within the framework of GOOS. Recognised Observers include IOC, ICES, ESA and EUROMAR.

EuroGOOS includes operational as well as research Agencies, and these have statutory obligations to provide forecasts, and to manage aspects of maritime safety, charting, navigation, coastal erosion, flooding, fisheries, and control of pollution. In many cases numerical modelling already provides the basis of forecasting phenomena such as storm surges, sea ice occurrence and thickness, wave field, or algae blooms. The members are therefore in a position to experiment with existing models, study new modelling systems, add new variables, and gradually up-grade forecasts by improved resolution, accuracy, or product types.

The First EuroGOOS Conference will take place in the Hague, Netherlands, October 8-11 1996. EuroGOOS organisation includes the following components:

(i) Science Advisory Working Group (SAWG)
(ii) Technology Plan Working Group (TPWG)
(iii) Economics and Market Research [Secretariat]
(iv) Regional Task Teams for Baltic, Arctic, Northwest European Shelf Seas, Mediterranean, and Atlantic,

The SAWG has responsibility to advise EuroGOOS on advances in modelling techniques, sampling strategy and limit of predictability. The TPWG has analysed the available instruments and systems in Europe, the new technology needed, and has started discussions with manufacturers of equipment. The TPWG is studying the technical opportunity for installing automatic measuring packages on a subset of the many hundreds of ferries operating in European Seas.

Economic studies and analysis of customer requirements are being carried out through national surveys of hundreds of potential marine data users in each European country,

The EuroGOOS Strategy depends on continuous up-grading of information on customer identification, user product requirements, new technology including remote sensing, operational system design, etc., as well as improved product distribution to customers.

Most European countries now have either a formal governmental committee or working group to co-ordinate interests in GOOS and EuroGOOS, or have an informal collaborative network with a Lead Agency.

ESF sponsored a workshop on Mediterranean Forecasting in Toulon in October 1995. The workshop was organized and convened by Dr. Nadia Pinardi (CNR, Italy). EuroGOOS discussed Mediterranean Forecasting at its annual meeting in November 1995, and established a Regional Task Team on Mediterranean Forecasting, chaired by Dr. Pinardi. The EuroGOOS Mediterranean Task Team met in Rome in April 1996, with representatives from agencies in France, Italy, Spain and UK, and expressions of interest with written inputs from agencies in Turkey, Israel, and Cyprus. Correspondence is in hand with agencies and individual experts in Greece, Egypt, Tunisia, Algeria and Morocco. Greek agencies are Members of EuroGOOS, and will almost certainly become more fully involved.

The EuroGOOS Regional Mediterranean Task Team is preparing proposals for E. U. funding to carry out experiments and trials for prototype operational modelling and forecasting in the Mediterranean. This project will last for about 3 years. EuroGOOS will use its best endeavors to identify agencies and experts in North Africa and the Middle East who wish to participate formally in operational forecasting in the Mediterranean. EuroGOOS will work closely with UNEP-MAP Athens, CIESM, and the E. U. Mediterranean support programmes in order to strengthen the involvement of all Mediterranean countries and relevant agencies. EuroGOOS will maintain close contact with IOC to ensure that official IOC delegations are properly informed of developments.

4.2 NEARGOOS

Su Jilan briefed the Committee on NEARGOOS, the Northeast Asia Regional GOOS marginal seas activity that currently involves Japan, China, Republic of South Korea and Russia with the potential future participation of the Democratic People’s Republic of Korea (see Annex IV). The Goals are (i) to provide data sets for assimilation in models for forecasting; (ii) to improve ocean services; and (iii) to provide information useful for mariculture, especially on harmful algal blooms; pollution monitoring; mitigation of natural disasters; coastal seas recreation; and fisheries efficiency. Initial objectives are to establish a real-time data base and a delayed-mode data base which are operationally linked. Real-time data are reported via GTS or e-mail. Periodically the real-time data sets are transferred to the delayed-mode data base. At present the physical data go to the NODC’s but chemistry and biology data have not been integrated into the data flow system yet.

At present the GTS is only viable as an exchange mechanism for temperature and salinity but not for real-time wave data. This creates a problem with respect to issuing timely information and short range forecasts on natural disasters. Su Jilan believed this will be a generic. problem for coastal components of GOOS. He invited GOOS to give this problem some thought and to propose corrective action (e. g., either improve the GTS or replace it by a new system).

Planning and coordinating are accomplished by a Coordinating Committee (with a chairman and vice chairman) made up of two members from each country. The IOC WESTPAC Office serves as the NEARGOOS secretariat.

4.3 NATIONAL OUTLOOKS

National reports were received from Australia, Canada, China, France, India, Japan, Nethelands, U. K., USA. These are summarized in Annex V.

5. UPDATE OF PROGRESS OF J-GOOS COLLABORATORS

5.1 I-GOOS

Glass reported on the I-GOOS activities that had transpired since J-GOOS-II. I-GOOS-II was held in June 1995 in Paris. The recommendations resulting from I-GOOS-II were approved by the IOC Assembly in resolution XVIII-II. This resolution was provided to the Committee as a background document for this meeting. Glass stated that in accordance with resolution XVIII-II, a Working Group on GOOS Services had been established and that a preliminary report was just recently completed by the Working Group Chairman, Johannes Guddal of Norway. That report was made available to the Committee and is included as Annex VI (without attachments) of this report.

A workshop on socio-economic aspects related to the development of GOOS is planned in connection with the I-GOOS Planning Session in Washington in May 1996. Another workshop, on capacity building to further the involvement of developing countries, is being considered for some future date. The preparation of a position paper (how to initiate it) is being considered for the next I-GOOS meeting.

5.1.1 The GOOS Strategy Sub-Committee (SSC)

The SSC held its second meeting in March 1996. Its main purpose was to define a GOOS Strategy. Glass informed J-GOOS that the finalization of the GOOS Strategic Plan was nearly completed. Regarding the development of a GOOS Space Plan, it was decided that the GCOS Space Observations Plan be adopted with GOOS aspects added to it (e.g., one could add references to HOTO and LMR needs, and data acquisition systems, i.e., ARGOS, etc.). Similarly, IODE and IGOSS would be the basis for data management with GOOS aspects added as required. The main themes for it having been agreed, a GOOS handbook is now under preparation.

Chairman Brown opened an unscheduled discussion on the structure of the Strategy Sub-Committee, its responsibilites and its functions. He believed there is a fundamental problem in that there is not enough interaction between I-GOOS SSC and J-GOOS members; thus a mechanism is needed to facilitate communication directly between the SSC and J-GOOS beyond that of being present at various meetings.

The ensuing debate brought forth several points, among them that constant and current science input to the SSC was a pressing issue, and that this input should come from J-GOOS, not from, other sources. Several ideas surfaced regarding restructuring the SSC so as to include some kind of joint I-GOOS-J-GOOS arrangement for its operation. It was agreed that the two chairmen would discuss this off-line and appropriate action could be taken intersessionally. It was also agreed that the stabilization of the GOOS Support Office with adequate staff and a permanent Director would help immensely to smooth the I-GOOS-J-GOOS interaction.

5.1.2 GOOS Priorities Agreement Process

Eric Lindstrom addressed the Committee on behalf of the *ad hoc* I-GOOS Working Group charged with planning for a “Priorities Agreement Meeting”. He described a “GOOS Agreement Process” as an attempt to orchestrate how GOOS would obtain formal intergovernmental commitments to implementation of GOOS elements.

The reasons behind the process were threefold:

(i) GOOS wants to “bank” some of the observing systems and products established by global research programmes.

(ii) GOOS wants immediate commitment to some GOOS-like program elements so as tore-invigorate the ongoing planning activity and begin generation of GOOS products.

(iii) GOOS wants to engage governments in a process leading to long-term commitments to ocean observations and products of benefit to society.

The process may be described briefly as follows:

(i) critical parameters, products and justifications are determined by J-GOOS scientific planning groups;

(ii) an assessment is made of candidate observing systems;

(iii) agreement is reached on required observations/systems suitable and ready for GOOS implementation (such as through the vehicle of a “GOOS Agreement Meeting”);

(iv) formal commitments are sought for the agreed program elements and stated at I-GOOS.

The above steps are iterated at a regular interval as the program grows and evolves.

Implementation of the agreement process was to be initiated through a document describing parts of the system and priority variables for observations in GOOS and a description of potential relevant contributions; plus an international meeting of “ocean agency” heads to reach informal agreement on implementation and likely national commitments. Such a “priorities agreement” meeting was planned for May 1996 (to be hosted by USA) but was postponed. Three primary difficulties were contributory to the postponement:

(i) There was lack of consensus on the scope of initial implementation; e.g., all J-GOOS scientific panels had not completed design work so priorities were not “well-founded”. Lindstrom believed that this is a criticism that must be addressed by J-GOOS.

(ii) There was incomplete agreement on the approach and its relationship to overall GOOS strategy. It (“the process”) cast a wide net for GOOS contributions, while it was the opinion of many that the process was intended only to “fast-track” implementation in GOOS of a few program elements those few being ones with well-established scientific design, clearly operational in nature, presently committed funds, and mature technology.

(iii) The USA agreed to host the first priorities agreement meeting but internal government problems this year (no budget; government shutdowns) and consequent uncertainty suggested that postponement may be prudent.

In order to address the first difficulty, Lindstrom asked J-GOOS to “review” the document’s interpretation of priorities and provide appropriate context for the module descriptions and parameter lists. He also believed it would be helpful to get some feedback on the idea of having a more focused approach to a priorities agreement meeting. He reasoned that having all aspects of GOOS represented and engaged in discussion of “commitments” and “implementation” might be premature (in light of scientific design progress to date, for example). An initial meeting focused more narrowly around a few elements of GOOS may be more compatible with planning to date and the preparations of governments to engage in GOOS commitments.

The meeting thanked Lindstrom for his presentation. O. Brown asked the module Panel chairmen (and any other committee member wishing to make comment) to review the relevant sections of the “Initial Priorities for GOOS” document and to send comments to Eric Lindstrom and Nic Flemming within two weeks. They would try to make revisions and bring the document to I-GOOS on 16-17 May 1996.

The Committee suggested that the document be revised with an emphasis on proceeding with initial implementation in GOOS of some established products rather than via “priorities”, i.e., to have the document be objective rather than parameter oriented. Observing priorities themselves are still being considered and debated in the scientific context and thus do not serve as the appropriate vehicle for initial meetings aimed at bringing existing observation systems and products into GOOS. Established data products and the observation systems and models that support them should be the focus of initial agreement and transformation to GOOS program elements.

5.2 GCOS

A. McEwan reported on the relevant intersessional developments since J-GOOS-II. JSTC-V was held in Hakone, Japan in October 1995. He believed the meeting was very effective due to a workshop approach. He noted a chair change: from J. Houghton to J. Townshend. McEwan mentioned several noteworthy accomplishments: completion of Version 1.0 of the GCOS Plan, the plan on Space Based Observations, and the plan on Data and Information Management. In addition 7 reports, 2 newsletters, and one brochure for the Conference of the Parties of the Framework Convention on Climate Change (FCCC) were issued.

In describing the current situation, McEwan stated that the emphasis is on implementation. He noted that there has been some reduction in resources from the sponsors and that the IOC obligations to support GCOS need to be met. There is growing concern that the implementation of the common ocean climate module is being impeded by the IOC GOOS emphasis on the Coastal Module,

The Space-Based Observations Plan has been sent to CEOS for comment. A meeting scheduled for 14-17 May 1996 in Ottawa will review the Data and Information Management Plan as well as the state of data documentation.

McEwan presented an outline of a GCOS review of implementation issues (see Annex VII). He concurred that the GOOS Space Plan should be formulated consistent with the GCOS Plan or integrated with it. McEwan noted a recommendation that the GCOS Joint Planning Office join with WWW, GAW, HWRP, GOOS, and GTOS to develop an approach to inventory existing systems.

T. Spence reported on the status of the various GCOS panels. John Morgan is the new chair of the Space-Based Observations Panel; G. Withee chairs the Data and Information Management Panel, He asked J-GOOS to consider, from its perspective, the functions of both the space and data panels. He invited the Committee to consider whether joint GCOS-GOOS-GTOS panels would be effective in addressing the needs of GOOS as well as those of the other global observing systems.

Spence noted that the OOPC is off to a good start and is utilizing the report of the OOSDP well. At its first meeting, the OOPC considered implementation issues. Regarding near-term implementation of the climate module, Spence was not optimistic that major enhancements would be possible. He cited the positive experience with programmes of WMO, By working with the technical commissions and regional associations, particular implementation activities are being initiated by the WMO Members. Regarding implementation of ocean observations, initial expectations were that many existing observational activities could be rapidly transformed to support GOOS, However, this transformation has proven to be very difficult.

Spence briefly updated the Committee on GTOS activities. He reported that the GTOS co-sponsors had accepted in principle the proposal of the GTOS Scientific and Technical Planning Group, FAO has offered to host the secretariat. The co-sponsors will set up a Steering Committee at their next meeting. While many observations are being taken in support of GTOS goals, Spence noted that there are few coordinated international activities. It is anticipated that FAO will provide a more operational orientation to GTOS than has been taken until now.

Clarke referred to experience with WOCE implementation that showed that nations do not have the infrastructure to do data management. WOCE usually ended up working through individuals for specific types of data. WOCE tried to find a permanent home for all its data sets - in a national data center - and for resources to do QA/QC, but most of the time, the people available to do this were in the research community. There were some failures, both with this system and with reliance on national data centers. Clarke stressed, however, that GOOS and GCOS must rely on national data centers since they MUST have long-term institutional funding commitments to maintain the system indefinitely (unlike more transient research programmes). Meteorological data centers are not the answer - oceanographic data is harder to collect and more sparse.

Brown stated that GOOS needs the data quality that WOCE has. He observed that the OOSDP had looked at the issue and concluded that the WOCE system was basically OK - “just compact it”. But the question of real-time data for applications in the coastal zone has not been resolved. Brown and Spence agreed to request that the sponsors meet together and address these and other issues of common concern to GOOS, GCOS and GTOS.

5.3 WCRP

Clarke informed the Committee that a number of WCRP activities are relevant to the development’ of GOOS-GCOS:

World Ocean Circulation Experiment - WOCE. The WOCE field program ends at the end of 1997. This will be followed by a data analysis and synthesis phase which is already being planned. This work should provide GOOS with techniques to describe certain aspects of the global ocean circulation and water mass distributions and properties.

The WOCE distributed data management scheme should be a valuable model for GOOS data management. WOCE believes that capturing data as early as possible in the data management scheme and providing information about the likely existence of data even before it is collected is an important part of data management. Putting cruise plans and cruise reports up in the public areas of the WOCE Data Information Unit encourages data flow. This process does in a more user-friendly way what the earlier IGOSS ROSCOP forms tried to do, but they were hard to fill out and didn't seem to go anywhere that was easily accessible to a wide audience.

WOCE also developed measurement protocols and data quality control procedures which should also be considered where appropriate in the design of GOOS. With modern computers, it is necessary to get well away from the rigid data formats of the past to allow data providers to include full descriptions of their measurement techniques and data processing methods with their data files.

Climate Variability and Predictability Programme - CLIVAR. This program began in 1995 and is presently continuing the field work associated with the tropical ocean that was begun by TOGA. CLIVAR has established an Upper Ocean Panel (UOP). This panel is charged with developing an upper ocean program that will permit CLIVAR to describe the upper ocean structure on some time and space scale (nominally monthly and 5 degree squares) first for the tropical ocean and then to higher latitudes. The UOP is intended to be a model-driven program. For the present, it will work closely with the OOPC with the hope that some day it will be disbanded and the OOPC or some other GOOS panel will fulfill that role.

Both the JSC and CLIVAR hope to use GOOS wherever possible to implement and manage its "routine" observations. As quickly as possible, this should include surface temperature and salinity fields (from satellites, ships, drifters), upper ocean temperature and salinity fields (from XBT's, XCTD's, moored buoys, near real time CTD casts, profiling ALACE floats, etc.), and ENSO prediction (observations and models).

CLIVAR is in the process of establishing an Asian-Australian Monsoon Panel which will design and implement a program to study the relationship between the tropical atmospheric circulation, the upper ocean and the Asian Monsoon and its variation. It will run two workshops (one this summer and one in the fall) on the design of a program to study the sources of decadal scale climate variability.

Global Energy and Water Cycle Experiments - GEWEX. This program works in a number of areas which are of interest to GOOS. GEWEX will be running several continental scale hydrological experiments aimed at improving our ability to go from "weather" information to river runoff on the large scale. GEWEX also carries the responsibility in the WCRP for the scientific oversight and management of global programmes associated with clouds, solar radiation and precipitation.

Arctic Climate System Study - ACSYS. ACSYS is a program that focuses on the arctic region, both the ocean and the atmosphere. It is currently responsible for the oversight for WCRP of sea-ice modelling and the Arctic Drifting Buoy Program (ADBP). The ADBP should become part of GOOS or GCOS.

Air Sea Fluxes. Air sea fluxes studies should be a central part of the WCRP; however, because the community is small and estimates of air-sea fluxes are an important element in each of the major ocean programmes, the problem with how to best deal with them in an integrated way has never been resolved. The JSC has established a small study group to continue to work on the questions related to how well air-sea flux estimates can be obtained directly from surface meteorological observations. CLIVAR NEG-1 is working on upper ocean models driven by atmospheric fields from the weather forecast models and constrained by upper ocean observations. NEG-1 will also be evaluating how well atmospheric forecast models estimate fluxes. Air-sea fluxes will also be an issue in the coupled ocean-atmosphere climate models which will be developed and evaluated within the work of CLIVAR NEG 2.

Modelling. JSC is concerned with the large number of modelling panels within its programmes and is trying to find an effective way of promoting communication between those groups. The present tactic is to assign two members of the JSC as rapporteurs for modelling and to encourage joint meetings between pairs of modelling panels. These joint meetings/workshops have occurred and seem to be both interesting scientifically to the panel members and valuable in the development of joint projects or the transfer of ideas and techniques.

6. GOOS MODULE DEVELOPMENT

6.1 HEALTH OF THE OCEAN MODULE (HOTO)

Neil Andersen, Chairman of the J-GOOS Panel for the Health of the Ocean (HOTO) Module, reported on the most recent developments in finalizing the HOTO Strategic Plan and the results of the third session of the HOTO Panel. It was stressed that although the plan could be reviewed as a final product at this time, it should also be seen as a continually evolving document that needs to be periodically revisited and updated to reflect new scientific developments and changing international circumstances and priorities. The report specifically noted that, in addition to interacting with other GOOS Modules, it would be beneficial to interact with certain international bodies (e.g., ICES, PICES, etc.). Andersen invited guidance by J-GOOS members on how best to achieve this interaction.

In its report the Panel expressed concern over recent trends that might affect the “free” exchange of data. There is a growing possibility that as institutions are forced to privatise and move toward cutting costs or increasing revenues, data will become less rather than more available. A communication has been sent to I-GOOS from the HOTO Panel and copied to J-GOOS, expressing this concern and it was requested that J-GOOS give priority to this subject in discussions with I-GOOS. It was also pointed out that the availability of existing data from national monitoring systems was also a pre-requisite for a successful GOOS.

The development of a framework for the preparation of regional blueprints for the HOTO Module was described and several examples that the Panel had drafted were brought to the attention of J-GOOS. The use of such blueprints was viewed by the Panel as a mechanism for conducting Pilot Projects to test the validity and comprehensiveness of the Strategic Plan for HOTO and to determine the specific measurements/variables required from other GOOS Modules/programmes to support/implement HOTO measurements and their interpretations. Pilot projects under consideration include one in the Arctic, and three that are related to the International Mussel Watch Programme, in the WESTPAC, Caribbean, and Chesapeake Bay regions. UNEP is an important action agency in the Mussel Watch projects and Andersen was hoping for indications of greater participation by UNEP than has occurred so far. It was noted that in many instances, the monitoring networks called for in the strategic Plan were presently implementable.

Andersen detailed an existing problem relating to human health considerations. In particular, he noted that there were conflicting views between epidemiologists and marine toxicologists on the interpretation of data relating to infectious diseases. He stressed that human health issues were an extremely important aspect of the HOTO Module. Accordingly, the resolution of this conflict of views should receive high priority.

The Committee thanked Andersen and the HOTO Panel for their efforts in generating a Strategic Plan. It was decided to accept the Plan and give it wide distribution. In addition to moving ahead with the regional implementation effort and toward some resolution of the toxicologist-epidemiologist conflict, the Committee expressed the need for the follow on HOTO Panel to move toward addressing the prognostic modelling aspects of HOTO. Governments would like to know, if certain mitigating actions are taken or not taken in response to some forecast health threat, what the likely results might be. J-GOOS formulated revised Terms of Reference (TOR) (Annex VIII) to reflect the foregoing charge to a reconstituted HOTO Panel. Andersen was invited to submit, in due course, a revised membership of the HOTO Panel to J-GOOS that would take into account the revised nature of HOTO.

6.2 LIVING MARINE RESOURCES MODULE (LMR)

Jim McCarthy presented a report of a workshop on planning for the Living Marine Resources module which took place at the University of Massachusetts, Dartmouth, in March 1996. He noted that J-GOOS-II had looked at the report of a much earlier *ad hoc* planning workshop held in Costa Rica which had no follow-up, and had raised several concerns. J-GOOS-II decided to take a fresh look at the LMR issue and given the relevance of the GLOBEC research initiative, to ask SCOR to assist in organizing a workshop. In spite of difficulties in timing, the workshop involved sixteen participants from six countries and was chaired by Dr. John Shepherd (UK).

Among the GOOS planning modules, the LMR community is probably least experienced in delivery of data products to users. The workshop recognized *a priori* that many observations necessary for LMR will be made under the aegis of planning for other modules - climate, HOTO and coastal zone.

One focus of the workshop report is the problem of bridging from local and regional to global scales. Recognizing that a single workshop could not deal with all issues relevant to LMR, discussion centered on three goals for LMR which were considered to be most important:

(i) ecological variables at trophic levels that underpin exploitable marine resources, particularly primary and secondary biological production;
(ii) sustainability of critical marine habitats;
(iii) regime shifts and changes in recruitment to fish populations.

Several other goals were identified, although these were more specific or had more regional dimensions than could be addressed at the workshop.

The workshop reviewed the need for observations at a wide variety of scales and concluded that while a number of the required capabilities are available now, and there have been many new technological developments, the potential of this new technology for use in an operational observing system has not been sufficiently explored.

The topic of “regime shifts” in marine ecosystems was a major concern for the workshop - these are major readjustments in population dominance at a particular trophic level. The best known examples are seen in large fluctuations in various Pacific populations of anchovies and sardines with no fishing pressure. These changes are preceded by, and could probably be predicted by, detectable changes in the relevant upwelling system that occur well in advance of the resultant changes in the abundance of phytoplankton and zooplankton, which subsequently impact the fisheries themselves. These are among the most economically important fisheries in the world, yet traditional monitoring methods have failed to forecast these significant shifts. Monitoring of “drifts” in the system might have payoff in useful predictions to fishing industries.

The workshop noted the relevance of the Large Marine Ecosystems (LME) programme. It is supported by the Global Environmental Fund (GEF) and other World Bank funds, as an example of a framework for standardized ecological observations with distinct regional components that LMR could build on for GOOS.

FAO’s assessment of the present state of LMR is that the immediate users are scientists and thus it saw no immediate role. This is true, but the workshop report reflects a sense of direction ramping up to a state where products for end users (i. e., non-scientists) will be made available.

The Committee discussed the workshop recommendations, particularly regarding the establishment of a Panel for LMR and the TOR (Annex IX) and membership for such a Panel. Regarding the issue of interactions with FAO, which has primary international responsibility for fisheries monitoring and stock assessments, J-GOOS agreed the work of FAO in this area is complementary to that being proposed for the LMR module.

Preliminary plans for LMR as described in the workshop report will be perceived as heavily dependent on current and future research. This is inevitable, given the immaturity of the field. It was pointed out, however, that in order to significantly increase curability to understand variability in living marine resources, such as fish stocks, a much greater understanding of the physical and biological processes affecting recruitment and skills in how to observe and model them is required, While this understanding is being developed, the scientific community, especially modellers, will be important users of LMR products. However, the overall emphasis will be the delivery of products to the broad user community, and this will be enhanced by maintaining a close coupling between LMR and other modules of GOOS.

Clarke pointed out that the present scheme for collecting fish catch data every three or four years is inadequate to make any sense of the data. We need to understand more fundamentally what is influencing the success of any year class. Moreover, at present, assessments are received too late by FAO from the reporting nations to do anything about limiting catch. Clarke noted and agreed with recommendation 3 in the report, that makes the point that links to fisheries organizations are needed. Though this is understood to include FAO, he stated that FAO should be mentioned specifically in future documents,

Several issues were identified which were not included in detail in the workshop considerations and which the new Panel should consider - these included additional trophic level detail, species composition, and developmental ecology of fish larvae. In particular, modelling efforts should expand beyond the traditional N-P-Z construct to include functional groups at each trophic level.

Woods encouraged an unrestricted view of end users, leaving the door open for LMR to provide for unanticipated users of LMR products. He mentioned that the energy industry is studying possibilities for fertilizing the ocean with nitrogen extracted from the air to stimulate fisheries products. J-GOOS agreed that the new Panel should give a high priority to identifying a broad spectrum of users.

Brown compared the present situation of LMR with OOPC. With respect to OOPC there are demonstrable, tested hypotheses, whereas in LMR we are still in the hypothesis stage where the demonstrability of the end-to-end linkage has not been proven. Traditional stock assessment will not, in the next decade, provide the knowledge that can lead to an understanding of environmental controls of the stocks. In this LMR effort we have an approach with models and observations that will. The first two actions proposed in the TOR are critical. The actual spectrum of the user community is not yet well identified. The science community will be users but the others remain to be identified. McCarthy cautioned that scientists will be users and contributors to LMR-GOOS, but will not rely on it. It is still very much in R and D stage. The LMR focus should be on how to direct products to users.

J-GOOS welcomed the workshop report and voiced appreciation for the willingness of the participants to meet on such short notice over a weekend, and for the particularly valuable assistance provided by Elizabeth Gross, Executive Director of SCOR, and John Shepherd, Director of the Southampton Oceanography Centre, in making the workshop a success. It was agreed that the workshop report should be made available as a working document and not a final plan,

J-GOOS approved the plan of action in the report and the TOR for a Panel. The chairman asked McCarthy to develop a list of potential candidates and invited the other members to submit suggested names to him as well. It was noted that the requested meeting of an LMR Panel was not included in the Budget for 1996 but the Committee concluded it was critical to maintaining momentum. J. Marton-Lefevre suggested that a proposal be prepared and sent to the Sponsors seeking additional funds to make this meeting possible (see Annex X). In response to Section 9 of the workshop report requesting clarification from J-GOOS of certain oversight responsibilities, J-GOOS decided that living marine resources in coastal areas and the matter of harmful algal blooms lie with the LMR module. Critical marine habitats are the province of the coastal module and diseases in relation to the health of humans and marine biota are HOTO subjects,

6.3 COASTAL MODULE (CM)

David Prandle summarized the Coastal Module progress to date. Planning for this module had been accelerated between J-GOOS-II and J-GOOS-III, as it was generally recognized that coastal issues were of primary concern to many countries. Despite an accelerated pace aimed at an initial workshop in July 1996, it could be expected that a final scientific design for the Coastal Module could take 2-3 years to complete - if the HOTO, LMR and OOSDP activities were considered as models.

At an *ad hoc* meeting called by Prandle the day prior to J-GOOS III, some initial discussion took place of a proposed workshop and a "strawman" Coastal Module description (provided to the Committee). That meeting included several J-GOOS members as well as invited guests who were scheduled participants in J-GOOS-III. A summary of that discussion is contained in Annex XI. One outcome was general agreement on how to deal with overlaps between the coastal module and other GOOS modules. Consistent with the GOOS "theme", the Coastal Panel should, initially, identify critical coastal zone observations that are NOT included in other module plans and proceed to detail the scientific requirements for those observations. It should build on this plan with observations detailed in other module plans and comment where necessary on special additional requirements imposed by their inclusion with the coastal design. It was not believed that the initial workshop would attempt any comprehensive prioritization of the observations. This recognizes the fact that coastal issues will have significant variability geographically and will require site-specific prioritization and design of detailed observation implementation plans. Some broad categorization of observations by coastal area may be possible at a later stage in the design process. J-GOOS generally agreed with this perspective.

A key overarching objective and product for the Coastal Module Design would be to provide a basis, in models and observations, for extended predictability of the coastal environment. This extension would aim at forecasts of more variables, improved accuracy and further ahead in time. The degree to which complex, non-linear, coupled physical-biological-chemical systems could be predicted and the degree to which modelling of such systems had advanced would be central scientific issues for the Panel. One objective in this approach would be to provide a model product that would stimulate local development of observational systems for initialization and verification of a model relevant in the local environment. It was emphasized that the ultimate success of coastal GOOS is the successful development of relevant regional coastal observing systems and predictive models. It is unlikely that these could, in detail, ever be specified in a global Coastal Module design document. An elaboration and scientific defense of the approach and factors relevant to successful local prescriptions are the likely outcome of the J-GOOS Coastal panel.

Difficulty in defining the most appropriate geographical border for the "Coastal Zone" to be addressed by the panel was not fully resolved. Given the model-oriented approach, dependence on provision of flux estimates in estuarine environments might be difficult. An approach emphasizing observations offshore and good boundary conditions from global models (especially designed with coastal forecasting in mind) would lessen the need for information outside GOOS. This approach may hamper product development coupled to pollution or development issues originating on the land side of the coast, but further elaboration of this issue could be expected as a result of the proposed workshop.

Prandle noted that, in addition to the proposed workshop, the Coastal Panel was likely to commission reports on the state of modelling relevant to the Coastal Module design, monitoring activities presently active in coastal zones, and existing operational systems relevant to coastal zone management.

It was generally recognized that the Coastal Module is not dealing with a global problem but an ubiquitous array of diverse local problems which may have some generic characteristics of global interest. These may be addressed in part through improved modelling coupled with appropriate observation suites. The Coastal Panel would necessarily have to provide many details as to how a nested set of models would work and their relationship with observing requirements.

The Committee thanked Dr Prandle for a concise and thought-provoking presentation. Prandle was requested to take the lead in developing plans for a coastal workshop (in Brisbane if attendance at the AGU was promising, or elsewhere if not) with the assistance of Bewers, Lindstrom, and Su. In addition to working toward an integrated observation system design for the coastal module, the workshop should also consider a strategy for a generic modelling component. The Committee re-emphasized the critical nature of the Coastal Module to GOOS and to coastal states and urged that interaction with UNEP and OCA/PAC (Ocean and Coastal Areas Programme Activities Center) be sought at the workshop.

6.4 OCEAN OBSERVATIONS PANEL FOR CLIMATE (OOPC)

Neville Smith informed the Committee on the outcome of OOPC-I held 25-27 March 1996, at RSMAS of the University of Miami. All members were present except T. Yamagata who had requested he be replaced on the Panel in the future by Professor Masaki Kawabe of the Ocean Research Institute, University of Tokyo (this was agreed to by J-GOOS and the other sponsors). Guests included R. Molinari, R. Reynolds, M. Lefebvre, O. Brown, E. Lindstrom, T. Manabe, and T. Spence. A detailed report of Smith's presentation on OOPC-I is in Annex XII. The principal agenda items were:

(i) Discussion of products and user needs and a strategy to bring the OOSDP Ocean Climate Oberving System (OCOS) design to this community.

The approach decided upon was to select key observation-to- product "lines", and starting with the application, develop end-to-end demonstrations that spell out the pathway in detail (e. g., El Nino forecasts and derivative products, targeting the role of in situ thermal data) in illustrative documents or brochures that demonstrate the value of these "lines".

(ii) Discussion of implementation issues surrounding (a) SST, (b) the ship-of-opportunity XBT program, (c) remote sensing, and (d) the priorities-for-GOOS document.

OOPC agreed to take on responsibility for providing more detailed and specific guidance to implementing groups (e. g., optimal observation networks, best measurement techniques, etc.) than is available in the OOSDP Report.

(iii) Outlining a strategy for OOPC.

In addition to the above, the OOPC strategy will include the commissioning of special background reports and workshops, updating the OOSDP Report every 3-4 years, and maintaining interaction with research programmes.

Smith briefly discussed the OOPC terms of reference (TOR). The OOPC would like to ensure that "ocean circulation" is seen to incorporate carbon; that explicit reference is made to "close" research groups (e.g., the CLIVAR UOP); and that operational (OOPC) vs research aims are clearer in the TOR.

Woods reminded the Committee that, at present, the generation of level-three fields and useful products depends on models which were not designed for this purpose and it is not surprising that often they do not do well. He cited the use of weather forecast models that produced poor quality surface flux fields. He believed this should be central to the agenda of OOPC-II and he enouraged J-GOOS to give attention to this as well. Well designed models are the underpinning for producing the best products.

The discussion brought out several concepts/suggestions that might be considered in the treatment of these end-to-end descriptions:

(i) Spell out the present end-to-end system for forecasting ENSO and, with answers from WOCE and TOGA research, what the new way will be.

(ii) The proposed brochures might be designed to give recognition to people doing the work e.g., the greeters of SOOP ships.

(iii) Be aware of the possibility that confusion at the funding agency level could result if each module separately approached the agencies with independently prepared brochures.

(iv) Keep in mind the so-far inadequately addressed question of what the impact is on the customer if, say, a million dollar weather ship is cut out of the budget. A loss of few % here and a few % there to some large industries is not an answer that persuades.

The Chairman thanked Smith and encouraged him to move OOPC ahead along the strategy outlined in his report.

6.5 SERVICES MODULE (SVS)

Both I-GOOS and J-GOOS established *ad hoc* working groups with virtually the same terms of reference and the same tasks during 1995. These working groups worked through correspondence. The I-GOOS working group was chaired by Johannes Guddal (Norway). The J-GOOS group consisted of G. Komen and N. Flemming. J-GOOS II defined the Services Module as follows:

> The Services Module concentrates on the common components of other GOOS Modules at the level of the technical and scientific issues of products and applications. It addresses the functions of communications, data transmission, modelling and dissemination of products required to produce services. It addresses scientific problems related to program delivery in GOOS.

Dr. Komen reported that the J-GOOS *ad hoc* working group worked in concert with Dr. Guddal. The primary activity over the past year was a survey of current international and national oceanographic services as well as assisting in the writing of the Initial Priorities Document for the Strategic Subcommittee of I-GOOS. He reported that the objectives of the Service Module were:

(i) accurate and comprehensive sensing of marine meteorological and oceanographic parameters
(ii) improved (automatic) data collection systems plus data processing systems
(iii) improved analysis, better forecasts and rapid dissemination of products to users

Komen pointed out that the Services Module activities are already underway, that they cut across the other modules and that they serve as the principal window to the user community. Because of the way that these services developed, there are a number of problems or gaps. In some cases:

(i) there is a lack of international infrastructure and standards;
(ii) there is an imbalance between the cost of the measurement and the subsequent data processing capacity;
(iii) there is poor coordination between the data and the types of products required;
(iv) there are few strategies to deal with commercialisation of services.

These services are not stagnant but are changing all the time. Governments are cost-cutting and this has impacted the amount of data available and the infrastructure associated with its delivery as products. Agencies are continuing to improve and upgrade models within their data product production and delivery systems. There are new technologies available for observing and transmitting the data.

The *ad-hoc* J-GOOS Working Group (Komen and Flemming) recommended that it be disbanded in its present form but that they continue to serve as J-GOOS rapporteurs on the I-GOOS panel. This recommendation was accepted.

There was some discussion after the presentation concerning the scope of the mandate of the Services Module. The anxiety arose from the Rapporteur's first objective for the Service Module which implies that the Service Module might be specifying the types of measurement systems needed. The view of J-GOOS II was reiterated, that the Service Module was to manage certain parts of data collection through product delivery; however, system design should lie within the other modules. The experts involved in the management of the collection of the data and the production of the data products should be involved in that discussion but not lead that discussion.

It was also noted that much of the existing marine services activities are focused on physical oceanographic parameters or marine meteorology. It is important for the other modules, in particular, the Health of the Oceans module to begin planning what sort of demands they are going to make on the Services Module.

As a result of the discussion, J-GOOS decided to distinguish two distinct activities that have previously been incorporated in the Services Module.

A. Marine Prediction

There are several activities which can loosely be bundled under "Marine Prediction", such as

- wave forecasts
- safety of life at sea
- tsunamis
- ship routing/efficiency
- storm surges.

J-GOOS decided that it should provide scientific guidance on the development of observing and modelling involved in marine prediction. An *ad hoc* group (Komen, Fleming and Smith) would draft a document which would identify the scientific and technical issues that need to be addressed for this activity.

B. Services for GOOS Modules

Each of the modules is concerned with data and information management issues and services. These include telemetry, communications, quality assurance, data assembly, data bases, archives, dissemination, etc. J-GOOS recognised that there are several activities underway upon which GOOS can build. These include:

(i) use of the GCOS Data and Information Management Panel;
(ii) direct interactions with IGOSS-IODE, and other WMO groups.

It was emphasised that J-GOOS should reinforce the principle that the scientific process of J-GOOS (the scientific designs, etc., of the constituent panels) MUST be done in concert with design for data and information management. Experience in research programmes, e.g., TOGA, showed this is critical. It was decided that, as a first step, the GOOS Director should be asked to draft a position paper which sets out the issues which are critical for GOOS. This work should take account of existing discussions underway in GCOS, IODE and IGOSS, and the report of the OOSDP which addressed many of these issues in relation to the climate module.

7. UPDATE ON CROSS CUTTING ISSUES

7.1 MODELLING

John Woods reported on the conclusions reached by the *ad hoc* modelling group of himself, McCarthy, Komen and Smith.

SCOPE. The GOOS interest lies in developing models for operational applications. Discussion suggested the models should cover a hierarchy of models (domain, scope, field):

- global, regional and local
- all aspects of J-GOOS: HOTO, LMR, CZ, Climate, marine forecasts.

It was pointed out that this development should be approached in a "spirit of joint venture" (meteorological and naval agencies with existing operational activities, and nascent activities elsewhere, were suggested as partners).

RESEARCH. It was noted that there are many numerical experimentation groups (NEGs) already in existence and attached to operational and (mainly) research activities. For example:

WCRP Programmes

- CLIVAR NEG-1, NEG-2
- WOCE Synthesis and Modelling WG
- Working Group on NE (cosponsored with CAS)
- GEWEX Numerical Experimentation Panel

IGBP programmes

- J-GOFS Synthesis group
- GLOBEC, LOICZ

The main question is: to what extent can these existing NEGs serve the purposes that are likely to be identified by J-GOOS? How should this interaction happen? It was noted that in certain areas, like climate, this interaction is already taking place (e. g., CLIVAR NEG-1). The aim is to establish operational-NEG links such as operate in meteorology.

THE GOOS TASK. The principal task can be described with the FGGE paradigm - that is the generation of Level III products for customers (e.g., a scientific 3-dimensional analysis). Another important task for GOOS modelling is in the resolution of observing system design questions through targetted numerical experimentation. These tasks might be performed by requesting specific experimentation. It was noted that the questions that may be asked by GOOS, where operational products are the ultimate aim, will often be different from those of interest in research. Such examples have already arisen, for example, in remote sensing and *in situ* SST for climate. The “model” for these activities is the methodology adopted in numerical weather prediction. It was pointed out that numerical experimentation and modelling is a fundamental theme of GOOS. The products of GOOS will more and more result from model interpretation of GOOS data.

CUSTOMERS. The customers of modelling are, in the main, those of GOOS. Governments and their agencies, commercial environmental services, commercial end users, research scientists.

STATE OF THE ART. One of the first modelling objectives of J-GOOS is to establish what the state of the art is in operational, and potential operational, modelling activities. There are several existing activities, mainly in meteorological agencies doing wave forecasts, storm surges, etc. Coastal models are being developed, often jointly between operational and research organisations, with a clear target of operational implementation.

Climate models are mostly in the research phase, as evidenced by the WCRP NEGs, but those associated with seasonal-to- interannual prediction are in many cases near implementation. J-GOOS must also acquaint itself with the many other curiosity-led research activities in universities, etc.

Somehow, J-GOOS should obtain a picture of the scope and breadth of relevant modelling activity, including the possible resources and expertise that may be available for the purposes of J-GOOS and its panels. Issues that can be identified at present are:

(i) data assimilation research - must be aware of the inadequacies of models which reduce their viability for data assimilation;

(ii) observing system sensitivity experiments (OSSEs) - noting the long history of such experimentation and the sometimes ambiguous results, and that the evolution of models sometimes does not keep apace with the required experimentation (FGGE and drifters as an example), J-GOOS should not be over optimistic in its reliance on OSSEs.

KEY PLAYERS. One of the pressing needs of J-GOOS is to identify major players who might be able to contribute resources and expertise, This is something that could be achieved with suitable staff support.

GOOS MODELLING TASKS. J-GOOS must clarify the principle design issues which must be addressed by numerical experimentation. For example, open ocean-coastal coupling, or impact of different observing systems.

ACTION. It was proposed to form an *ad hoc* group of J-GOOS members (Woods, Smith, McCarthy, Prandle, Komen plus a HOTO member) and possibly co-opted experts to provide advice, develop policy and develop contacts with respect to GOOS modelling needs. The group should propose initial tasks for numerical experimentation. It is not anticipated that this *ad hoc* group will meet other than by electronic correspondence. Resources (or staff) may be needed for tasks like assessing existing activities, NEGs, etc.

During the ensuing discussion, the question was raised as to how far GOOS extends its modelling involvement, e.g., in implementation issues associated with storm surge models in the meteorological agencies. Komen mentioned modelling for services, like wave modelling. Prandl noted the invaluable experience of feedback from implemented systems on the R&D process - a similar experience to meteorology. Others asked whether a GOOS “context” was going to add value to some of the nascent/existing operational activities, like sea-ice forecasting. The joint venture concept was stressed, with navies as potential partners.

The Chairman believed that the members were in agreement with the proposal for an *ad hoc* group with the membership suggested (above) and indicated he would appoint a chairman in due course.

7.2 SATELLITE OBSERVATIONS

Michel Lefebvre reported to the Committee on the international developments of platforms and sensors for space-based observations. He addressed the question of moving towards an operational space system for oceanography and the policy direction needed for an eventual permanent ocean observing system. His presentation covered. the rationale for such a system, the techniques available and under development and the plans for platforms. He apologized that he had received the schedule for the Indian Satellite Programme too late to be included in his presentation. Copies of the overheads are contained in Annex XIII.

The Committee agreed that the development of a dependable space system, that allows for replacement in case of failure, will be an evolving process involving continuing interaction between the space based and surface based requirements. Future plans must address a full integration of surface and space measurements in meeting observational requirements dictated by models.

John Withrow reported that the IOC Remote Sensing program derives its requirements for remotely sensed data from the panels of GOOS. At this time, two panels have generated such requirements, the Climate Panel and the Services Panel. The requirements developed by these panels are reviewed by the GCOS Data Panel in the case of Climate, and the Joint CMM-IGOSS-IODE Sub-Group on Oceanic Satellites and Remote Sensing (OSRS) in the case of both climate and services. The review does not include the scientific justification, which is the purview of the panels, but only the technical aspects of the requirement.

Withrow noted that international cooperation, particularly in satellite ocean color remote sensing of the global and coastal oceans, is very timely owing to the large number of sensors planned for launch over the next 10 years. An international Ocean Color Coordination Group was formed by IOC and endorsed and supported by the Committee on Earth Observation Satellites (CEOS) in Montreal, 13-15 October 1995. This group will serve as a focal point for International Ocean Colour Activities. The Group held its first meeting in Toulouse, 22-23 March 1996, focusing on ocean color calibration and validation which is viewed as a key near term activity area. A more detailed report of Withrow’s presentation is in Annex XIV.

Geoff Holland attended the *ad hoc* Working Group of CEOS that met in Seattle, in March 1996, to discuss the possibility of forming an Integrated Global Observing Strategy (IGOS) that would bring the surface and satellite observing systems together and could be used as a planning tool for both. His report of the meeting is attached as Annex XV. He told the Committee there was a consensus in Seattle that such a strategy should be pursued and that in his opinion it would be to the advantage of the ocean community to be involved. A supplementary meeting to address the same topic from the point of view of the surface-based programmes will be held in Geneva in September this year. It was decided that J-GOOS would be represented at this meeting. T. Spence, Director of GCOS, gave some additional information regarding the background and development of the IGOS initiative by CEOS.

T. Spence described the activities of the GCOS Space Panel and suggested that the activities of the GCOS panel would be nearly the same as a similar panel formed in the context of GOOS to address its satellite needs. He suggested that the formation of a joint GCOS-GOOS Panel would be a way to take advantage of the ocean expertise in both areas without creating another series of meetings. As a combined panel (perhaps later with GTOS) it would also have a stronger voice with the space agencies. The meeting agreed with this approach and asked McCarthy, Andersen, Smith, Prandle, and Lefevre to provide nominations to Spence when he requested representation from GOOS on the combined GCOS-GOOS panel. Spence believed that the sponsors of the global observing systems should consider taking a more proactive role in CEOS, and encourage CEOS members to develop programmes that support the space requirements as articulated by the global observing systems.

8. RECAPITULATION OF DECISIONS AND THEIR IMPLICATIONS

8.1 ASSIGNMENTS OF RESPONSIBILITIES

J-GOOS	M. Bewers appointed as Vice Chair for J-GOOS. Bewers chaired the last day of J-GOOS-III as Brown had an unresolvable schedule conflict involving the Administration of the University of Miami.
J-GOOS	O. Brown, with the assistance of J. Woods, A. McEwan and possibly A. Clarke and M. Bewers, to undertake the preparation of a draft J-GOOS scientific plan for consideration at J-GOOS-IV. This document is intended to represent a J-GOOS-determined direction, that is, it will go beyond the issues brought to J-GOOS by its sub-bodies. As this plan is being written, it is anticipated that issues will be debated and decided which will be important in providing a compass for J-GOOS, Such a document would help provide clarification for all those that are trying to understand what GOOS and J-GOOS are about.
J-GOOS	Should consider its 1997 budget NOW and be prepared with budget estimates for 1998 at J-GOOS-IV. J-GOOS members acting as chairs or leads (until chairs are appointed) to submit budgets for 1997 by 1 June 1996, and for 1998 activities by 1 Dec 1996, to Brown and Alexiou.
J-GOOS	Smith, McCarthy, Andersen, Prandle, and Komen to submit comments to Lindstrom on the Priorities Document; Brown to write on the process.
HOTO	Needs to be reconstituted in accordance with the revised TOR. Neil Andersen, to remain as chair, and to submit candidate names to O. Brown and M. Bewers for new membership.
LMR	J-GOOS members to send suggestions for membership and chairman for LMR Panel (10-member Panel) to Brown and Bewers. J. McCarthy's proposal for an unbudgeted workshop in 1996 to be submitted to the sponsors for decision on extrabudgetary funding.
CM	Prandle, assisted by Bewers, Lindstrom and Su to proceed with organizing CM workshop of approximately 15 people. McCarthy and Anderson to suggest participants. Hold at

best place to attract the right people. Left up to Prandle in consultation with Brown and sponsors to decide best course of action.

SVS — O. Brown to ask GOOS Support Office Director to draft a position paper which sets out the services issues which are critical for GOOS. This work should take account of existing discussions underway in GCOS, IODE and IGOSS.

MODELS — Woods, Komen, Prandle, McCarthy, Smith and a HOTO Rep (to be nominated by Andersen) to form a nucleus of a J-GOOS advisory group to seek out ways to form partnerships with major modelling labs and to generate activities leading to GOOS operational models. Brown to assign a chair. This nucleus should be augmented by other experts to be nominated by the appointed chair.

SPACE — McCarthy, Andersen, Smith, Prandle, and Lefevre to provide to Spence when requested, nominations to represent GOOS on the combined GCOS-GOOS panel.

SPONSORS — Determine uncharged staff support provided to J-GOOS activities by ICSU, IOC, WMO, SCOR, etc. and include man-year estimates in future budgets.

SPONSORS — The questions of GOOS uniform data standards and transmission of real-time data for applications in the coastal zone have not been resolved. Brown and Spence agreed to request the sponsors to meet together and address these and other issues of common concern to GOOS, GCOS and GTOS.

SPONSORS — Cover design and standard distribution for various types of GOOS reports needs to be decided along with a numbering system.

8.2 IMPLICATIONS OF DECISIONS

HOTO — Funding ($25 ,000) available in current budget - should be ample, depending on location of meeting. Secretariat support secured at University of Maryland. No IOC secretariat impact, provided chairmanship of Panel does not change. Andersen to rely on GOOS Support Office, Paris, for such items as document distribution.

CM — Funding ($9,000) in current budget is insufficient if workshop is held separate from AGU at another venue. Some readjustment of the approved budget may be called for. Highest priority activity for J-GOOS in 1996/97 intersessional period. Needs IOC Secretariat support immediately, about 3 man-months per year.

LMR — No provision in approved 1996 budget for proposed Panel meeting in 1996. Continuing SCOR staff support for LMR activities requires negotiation with SCOR Executive. for about 2 man-months per year. Otherwise, LMR will have to rely for staff support on IOC. TOR require draft outline plan to be presented to J-GOOS-IV. Budget for LMR meeting should be a second priority in 1996. McCarthy cannot seek a chair, however, without financial commitment for LMR activities.

SVS — Requires staff suport for liaison with other data management activities - IODE. GCOS panel, etc., probably 3 man-months per year.

CLIMATE — Support required for OOPC members to participate in related meetings, 3-4 meetings per year, one person per meeting. Existing 1996 OOPC budget close to adequate. IOC staff support OK.

SPACE — Support required for Panel reps to participate in the combined GCOS-GOOS Space Observations Panel.

9. DATE AND PLACE OF NEXT MEETING

The Committee accepted the invitation of the chair to hold J-GOOS-IV at the Rosenstiel School of Marine and Atmospheric Sciences of the University of Miami during the latter part of April 1997. Brown would fix the date after determining when the seasonal rates for hotels change from the high period.

ANNEX I

AGENDA

1. OPENING

2. ADOPTION OF AGENDA

3. AMINISTRATIVE MATTERS

   3.1 GOOS ON THE WORLD WIDE WEBB
   3.2 J-GOOS BUDGET

4. REGIONAL AND NATIONAL OUTLOOKS

   4.1 EUROGOOS
   4.2 NEARGOOS
   4.3 NATIONAL OUTLOOKS

5. UPDATE OF PROGRESS ON J-GOOS COLLABORATORS

   5.1 I-GOOS

      5.1.1 The GOOS Strategy Sub-Committee (SSC)
      5.1.2 GOOS Priorities Agreement Process

   5.2 GCOS
   5.3 WCRP

6. GOOS MODULE DEVELOPMENT

   6.1 HEALTH OF THE OCEAN MODULE (HOTO)
   6.2 LIVING MARINE RESOURCES MODULE (LMR)
   6.3 COASTAL MODULE (CM)
   6.4 OCEAN OBSERVATIONS PANEL FOR CLIMATE (OOPC)
   6.5 SERVICES MODULE (SVS)

7. UPDATE ON CROSS-CUTTING ISSUES

   7.1 MODELLING
   7.2 SATELLITE OBSERVATIONS

8. RECAPITULATION OF DECISIONS AND THEIR IMPLICATIONS

   8.1 ASSIGNMENTS OF RESPONSIBILITIES
   8.2 IMPLICATIONS OF DECISIONS

9. DATE AND PLACE OF NEXT MEETING

ANNEX II

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ANNEX III

J-GOOS BUDGET FOR 1996

INCOME:

Contributions received to date:

Grant from ICSU	$20,000	
Contributions expected:		
- Contract from IOC	$32,600*	
- Additional contribution from IOC	$16,000	
- Grant from WMO	$10,000	
- Contributions for the OOPC meeting:		
from IOC	$8,000	
from GCOS	$8,000	
from WCRP	$8,000	
Total Expected Income		$102,600

ESTIMATED EXPENDITURE:

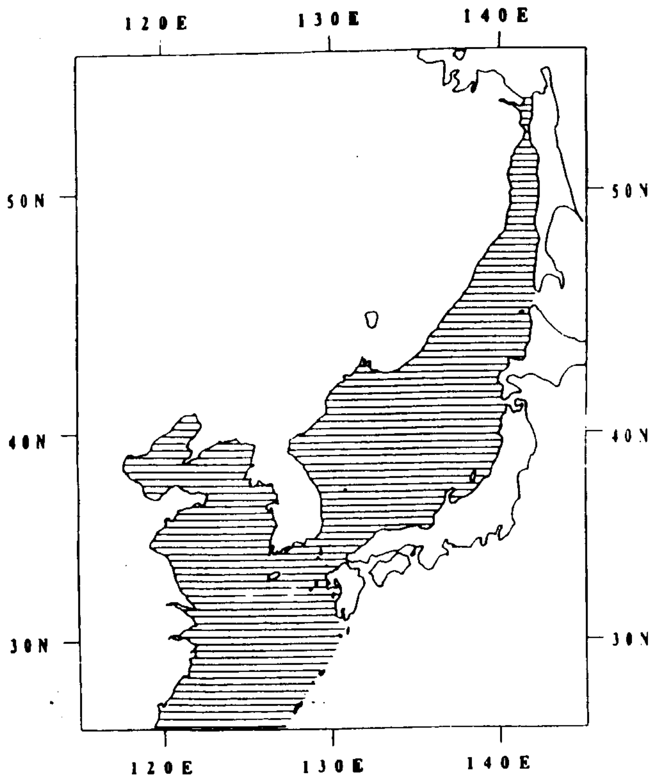
Scientific Meetings:	
LMR Workshop, Dartmouth, March 96	$22,000
OOPC Panel Meeting, Miami, March 96	$24,000
J-GOOS-III Meeting, Paris, April 96	$32,000
Coastal Zone Workshop, Brisbane, July 96	$9,000
HOTO Panel Meeting	$25,000
Study Papers:	
Modelling	$7,500
To be determined	$7,500
J-GOOS Contingencies:	$3,000
(miscellaneous travel)	
Total Expected Expenditure:	$130,000
EXCESS OF ESTIMATED EXPENDITURE OVER INCOME	($27,400)
BALANCE at 31 December 1995 held by ICSU:	$24,742
EXPECTED NET at 31 December 1996:	($ 2,658)

* Original UNESCO Contract in 1995 was for $32,000, of which $14,400 were received in 1995. Thus, $17,600 remained outstanding. In March 96, ICSU received an amendment of $15,000, bringing the total contract to $47,000, of which $32,600 are still expected and should be received in 1996.

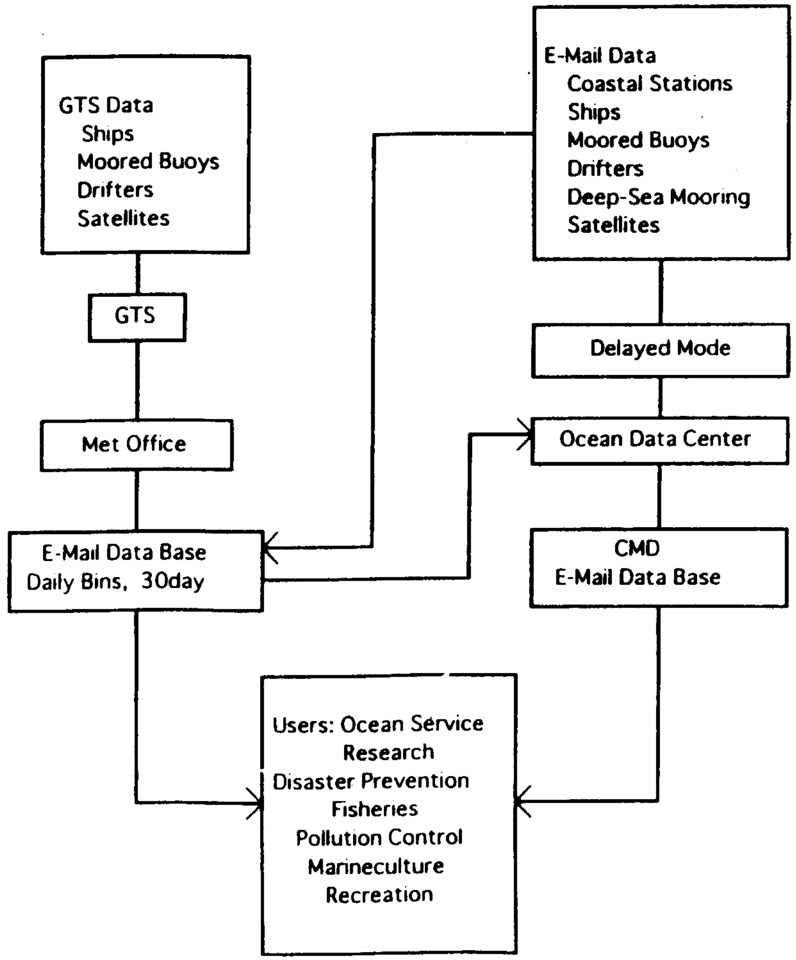
ANNEX IV

NEAR-GOOS REGION AND DATA FLOW

NEAR-GOOS AREA



NEAR-GOOS Data Flow



ANNEX V

NATIONAL REPORTS

AUSTRALIA

Australia has organized its GCOS and GOOS activities under the umbrella of a Joint Working Group for GCOS/GOOS, with national sponsors roughly aligned with the international sponsors of these endeavors, This JWG has in turn created an Expert Sub-Group for GOOS, chaired by Neville Smith, and an Expert Sub-Group for GCOS (excluding the ocean component) now chaired by M. Manton.

The GOOS ESG first met in 1993 and set down a work plan which would produce a scientific plan for an Australian GOOS contribution, at that time with a schedule of producing this report by 1995. As part of this work plan, the need for a survey of existing monitoring and user needs was identified. This schedule was disrupted through a Commonwealth initiative for a Coastal Policy, within which a coastal monitoring system was proposed. The GOOS ESG began work with the department of Environment on this activity in late 1994 and the Commonwealth Coastal Policy was announced in early 1995. However, for various reasons, work on the specification of a Coastal Monitoring System was delayed until late 1995. Collaboration since has led to an approach with a) a consultancy to create a “directory” of Australian monitoring activity, focused on the Coastal Zone but inclusive of all parts of GOOS; b) creation of several (about 6) monitoring nodes at selected sites within the coastal zone around Australia (the Policy is very much focused on the land-sea interface of the coastal zone); and c) local components. Several workshops will be held to make progress on this.

While the final outcome is not quite as the ESG hoped for GOOS, it does represent a commitment to coastal zone monitoring and, it is hoped, will form a basis for a more substantial GOOS contribution in the future. For climate, there has been some progress toward seeking operational support for systems that were supported previously within TOGA by research funding; tough budgetary measures may make this transition more difficult.

CSIRO Division of Oceanography, in collaboration with the Bureau of Meteorology, are also undertaking research toward a coastal forecasting system for the Australian EEZ. This activity is some way of operational support but the plan clearly includes this as a long-term goal.

As part of the GCOS/GOOS planning, the Bureau of Meteorology has established a position which will, among other things, provide secretariat support to the GCOS and GOOS activities (Phil Riley). He is to be the first point of contact for GOOS activities.

CANADA

Canada has not yet established a national committee for GOOS. Under the Canadian Climate Program Board, a Canadian National Committee for GCOS (CNC-GCOS) has been established of which GOOS is a part. A report has been published by CNC-GCOS that focussed on the benefits from a climate observing system and the foreseen gaps.

Canada is presently pursuing a Canada Ocean Act which is expected to be enacted shortly and will involve the development of an ocean management strategy. It is expected that the strategy will focus on the coastal needs, and indeed the progress towards a Canadian GOOS will no doubt follow that in many countries and commence in coastal areas. In this, Canada will be encouraged through interaction with the US and Arctic neighbors in areas to the south and north respectively.

CHINA, PEOPLE’S REPUBLIC OF

In China, the State Oceanic Administration (SOA) is the sole agency responsible for the implementation of China’s GOOS. Consequently, other than an internal GOOS Coordination Group within SOA, no national GOOS committee has been established yet. However, SOA does have the intention to set up a national GOOS committee for China in the near future.

As to ocean monitoring activities, SOA has maintained sea-level stations and routine hydrographic sections for over 30 years, as well as data buoys since the 1980s. SOA has also proposed to the Central Government to upgrade and broaden the existing ocean monitoring system, including the establishment of a marine economic information system. Finally, SOA is active in promoting, and eventually will implement, the NEAR GOOS.

FRANCE

There is no formal GOOS Committee in France. However, a Committee of Heads of Oceanographic Institutions (CDO), which brings together the 7 main French institutions, examines the possible GOOS projects.

CDO has nominated a GOOS-France bureau, the role of which is to prepare propositions to be made to the French Government on the possible French activity in GOOS. For that purpose, and after consulting the scientific community, 6 topical working groups were constituted, in order to make proposals for certain modules. On the other hand, a GOOS-France Scientific Committee was set up to assess the quality of the proposals.

At present, 4 proposals have been written and were examined by the Scientific Committee in April 1996. One proposal is devoted to a preparation of a global fine mesh (1/6∞) operational ocean modelling. Dubbed ARAGO, it is divided into 3 sub-components: a space segment relying mainly on altimetric data (possibly from TOPEX/POSEIDON Follow-On), a global operational model and the associated data assimilation system (MERCATOR), and the in situ component dubbed ARAGO. This proposal can clearly have an international character.

A second proposal is devoted to the possible role in the Climate Module. This proposal is still at an early stage, but it will be devoted to a possible continuation of the actions in the Pacific Ocean (TAO Array) and to a new observational array in the Tropical Atlantic Ocean in collaboration with Brazil and USA dubbed PIRATA (Pilot Research mooring Array in the Tropical Atlantic).

A third proposal is devoted to Integrated Networks in the Coastal Zone. It proposes an extension of the already existing networks along the French Coast, including tide gauge measurements and sediment transport.

The fourth proposal is devoted to Technology associated with the other proposals. At present, it is restricted to devices measuring the physical parameters of the oceans, but it will be extended to other parameters, including biological parameters.
The Scientific Committee reviewed these proposals and asked for modifications before the end of 1996 before a formal presentation to CDO.

The Scientific Committee requested to have a clear document on the already existing operational activities and also to have a document on the possible implication in the Living Marine Resources. Two Working Groups were constituted for that purpose.
When the proposals are complete, a second French scientific GOOS workshop will be convened (probably in early 1997).

INDIA

National Contributions

India has large institutional investments in oceanographic research. Its long coastline and vast exclusive economic zone warrant constant watch of the processes in the seas around peninsular India. Around fifty institutions contribute to Indian oceanology directly or indirectly. This is mainly due to the perception that Indian agricultural economy and social welfare are closely linked with ocean development. Coordinating the activities of the individual organizations and interweaving them into the fabric of national and global science and technology are at the top of our national S & T agenda. It is with this in the background the Global Ocean Observing System is perceived as a proactive step towards achieving this objective. GOOS-India programmes are thus diverse in activities but unified in spirit.

National Capabilities

Underway observations:

Fully equipped Oceanographic Research Vessels (state-owned and chartered)
Dedicated survey vessels
Ships of opportunity (commercial, naval)
Instrumented crafts (boats, offshore rigs)

Shore-based observations:

Tide gauges, automatic weather stations, multi-purpose analytical laboratories.

Anchored/moored observations:

Direct-reading and recording current meters, doppler current profilers, water level recorders, moored data buoys, automatic weather stations, wave recorders, CTD systems, spectrophotometers, analytical facilities.

Drifting observations:

Drifters, multi-parameter data buoys with ARGOS and INSAT links

Remote sensing:

Oceansat
Satellite data receiving stations
Image processing systems
Sea truthing programmes
Interpretational algorithms

Acoustic tomography:

Tomographic transceivers
Analysis capabilities

Modelling:

Tide models
Estuarine models
Circulation models
Dispersion models
Oil spill models
Storm surge models
Sedimentation models
[Ecological models]

Data base:

Inventories of Cruise track and data
Responsible National Oceanographic Data Centre
Interactive documentation handling

Computational power:

Dedicated and general work stations
Access to super computers
Graphics facilities
Multi-media software
GIS packages

Information handling:

Access to Internet
[Ocean page in Internet]
Local Area Networks
Satellite communication: ernet, ren.nic

Observational Programmes

Since 1989, the coastal and adjoining offshore waters are monitored regularly to assess the levels of various pollutants in our seas. The Coastal Ocean Monitoring and Prediction System (COMAPS) has identified several areas of environmental concern. They are routinely monitored pre & post-monsoon.

Similar coordinated efforts are underway to assess variations in the sea level due to climatic changes and impact of such variations on the coastal belt of India. Modern tide gauges are being established at 11 stations for accurate measurement of tides. This, in conjunction with preparation of precise contour maps of the coastal region, will take this SELMAM (Sea Level Monitoring and Modelling) project some way in predicting sea level variations and storm surges.

The IOC-UNEP-WMO Pilot Activity on Sea-Level Changes and Associated Coastal Impacts (see IOC/INF-908) is being implemented in the Indian Ocean since 1993. The Pilot Activity envisages to secure high quality sea-level data, to analyze these data to identify important features of variability, and to undertake research to understand the causes behind these features in the Indian Ocean.

In response to the appeal from the IOC to participate in the Pilot Activity, Bangladesh, Kenya, Madagascar, Malaysia, Maldives, Mauritius and Mozambique have established cells for monitoring and analysis of sea-level (CMAS). Tanzania participates in the activities of the Pilot Activity, Seychelles has offered to support it by making sea-level data from its stations available to interested researchers, Australia, throughout its National Tidal Facility, lends active support to the Pilot Activity and Sri Lanka has expressed interests in setting up a CMAS in the near future.

The Pilot Activity planning workshop met in 1994, concluded that the most important challenge for the Pilot Activity is to enhance the expertise available in participating countries through training programmes, and recommended organizing of a “hands-on” training workshop where the participants will be trained, by experts from different sea level centres, in microcomputer based analysis of sea-level data. The IOC Group of Experts on the Global Sea Level Observing System (GE-GLOSS), supported the proposal and requested the IOC to provide finance for the Training Workshop . The IOC accepted an invitation from the Department of Ocean Development (Government of India), New Delhi, to host the workshop. The Department of Ocean Development also provided financial support towards local organization of the workshop.

This workshop, called GLOSS-GOOS Training Workshop on Sea-Level Data Analysis, was held at the Survey of India, Debra Dun during 1995. Nominees from Bangladesh, India, Kenya, Madagascar, Malaysia, Maldives, Mauritius and Tanzania attended the workshop which had faculty drawn from the TOGA Sea-Level Centre (USA), National Tidal Facility (Australia), Proudman Oceanographic Laboratory (UK), National Institute of Oceanography (India) and the Geodetic and Research Branch, Survey of India.

A Marine Satellite and Information Service (MARSIS) was initiated in 1990 with a view to making satellite-derived ocean data and data products available for operational use, Necessary infrastructural facilities for retrieval, analysis and validation of satellite derived data and for dissemination of data products have been created at National Remote Sensing Agency, Hyderabad (NRSA) and Space Application Centre, Ahmedabad (SAC). National Institute of Oceanography, Goa (NIO) has been equipped to collect sea truth data required for validation purposes. Modelling component is handled by CSIR Centre for Mathematical Modelling and Computer Simulation, Bangalore (CMMACS). Sea Surface Temperature (SST) and Potential Fishing Zone (PFZ) advisories are issued regularly. Soon additional data products comprising chlorophyll maps, monthly mean heat budget maps, histogram on monthly averaged mixed layer variation, weekly averaged ocean eddy maps, models for hindcast/forecast of waves, wave energy potential atlases, and maps on wetland landform categories and erosional/depositional features of the coastal areas will be made available. During 1996-2001, thirteen satellites including the recently launched P3-OCM/IRS satellite and the dedicated OceanSat are planned in orbit to enable studies relating to ocean parameters.

An important step towards satisfying the requirements of regional users and participants, both meteorological and oceanographic, is the initiation of Data Buoy Programme. Drifting buoy programme 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 Programme aimed at developing the MARSIS for the Indian seas. More than 30 drifters have been deployed in the last five years, and the data on surface meteorological and oceanographic parameters were acquired through ARGOS system. A few prototype drifters have been developed indigenously. Plans are to deploy 10 drifters per year. The data have benefitted short and medium range weather forecasting.

Co-ordinated closely with World Ocean Circulation Experiment (WOCE) and Climatic Variability studies (CLIVAR), Data Buoy Cooperation Panel (DBCP) has recognized the potential of this initiative in the International Buoy Programme for the Indian Ocean (IBPIO). Global Climate Observing System (GCOS) and Global Ocean Observing System (GOOS) would eventually provide requirements which IBPIO would be called upon to address. IBPIO will establish and maintain a network of platforms in the Indian Ocean to provide meteorological and oceanographic data for both real time operational requirements and research purposes, including support to World Weather Watch (WWW), GCOS, World Climate Research Programme (WCRP) and GOOS.

All these 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-recognized Responsible National Oceanographic Data Centre (RNODC) at NIO.

Ocean modelling efforts have been directed towards marine productivity, moist feedback in large-scale tropical circulation, effect of land-ocean contrast on tropical circulation, sea level changes, basin scale ocean modelling, air-sea interaction and coupled intra-seasonal oscillation, interannual variability in the Indian Ocean, modelling and early warning of tropical cyclones, storm surge prediction, global circulation, estuarine circulation, coastal circulation, pollutant dispersion, sediment transport, etc.

Scientific Programmes Requiring GOOS[India]

The Indian scientific programmes will derive benefit from the five modules of GOOS, namely:

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

In addition the country has plans for the deployment of 12 fully instrumented data buoys -8 within the EEZ and 4 in deep waters. The data buoys will be equipped with meteorological and oceanographic sensors to collect the time-series data. The real time data transmission to the shore station will take place through the Indian satellite.

The spinoff of Monsoon Experiment (MONEX) was Tropical Ocean Global Atmosphere (TOGA) programme with its repetitive and definite probing of the temperature structure of the sea using ships of opportunity in the Indian Ocean.

India is also contributing to the World Ocean Circulation Experiment (WOCE).

India's participation in the Joint Global Ocean Flux Study (JGOFS) aims 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. Data on primary production, phytoplankton pigments, new production, distribution and abundance of mesoplankton/microplankton, bacterial abundance, temperature, salinity, dissolved oxygen, nutrients, total carbon dioxide, ammonia, mass flux, carbonate and organifluxes, methane and carbon dioxide in surface air, nitrous oxide of water column, and sediment flux have been generated. An important addition to this International Geosphere-Biosphere Programme (IGBP) is the component to study Land-Ocean Interaction through Coastal Zone (LOICZ).

A major ocean acoustic tomographic study (OATS) has been launched. With the participation in the Heard Island experiment, necessary capabilities have been built to handle OATS in a more detailed scale.

Other major R&D programmes include:

Scientific research in Antarctica
Deep sea bed exploration for polymetallic nodules
Surveys for assessment of living and nonliving resources
Island development studies
Environmental Impact Assessment of deep sea mining
Drugs from the sea
Integrated studies of the deep sea fan of Bay of Bengal
Coastal ocean design and prediction system for hazard mitigation

Permanent reference stations are envisaged in two offshore islands. one in Lakshadweep in the Arabian Sea and the other in Andaman-Nicobar Island in the Bay of Bengal.

A programme to be funded by the Global Environment Facility (GEF) is planned to determine the biodiversity of the fauna and flora of the Indian Ocean region. A marine aquarium is planned in Andamans.

A Blue Triangle between India, Australia and South Africa to study the Indian Ocean in all respects in detail is being formed.

An integrated study of peripheral oceanographic systems such as Gulf of Kachchh, Gulf of Khambhat, estuaries and creeks is also planned to complement modelling of Large Marine Ecosystems (LME).

These are expected, not only to generate real-time data for operational purposes, but also for generating site-specific, regional-scale, basin-scale and global-scale models for prognostic purposes.

Coastal Module and Space Plan

Coastal processes are born out of the interplay between land, atmosphere and ocean and are shaped constantly by natural variations in the interaction between the litho-, atmo- and hydrospheres. Developmental activities in the world's coastal zones in the last few decades, however, have accelerated variations - of coastal processes. The Coastal Module recognizes that the very nature of these variations calls for replacement of conventional observing system of point measurements by, or substantiation of it with, synoptic ones. The latter can be in the form of a grid of sampling points, a network of sensors on moored buoys, air-borne or satellite borne sensors. The degree of synoptic coverage in terms of continuity and repetition, closeness to real-time data acquisition and cost-effectiveness increases from the grid of sampling points to sensors on space platforms, in that order, and render the last one the most attractive tool albeit the most difficult for the realization of the goals of the Coastal Module.

Sensors on satellites come tailor-made for specific parameters, operating in both passive and active modes (Appendix), Oceanographic applications of remote sensing include measurements of such diverse parameters as sea surface temperature, plankton pigments, concentration of suspended particles, wave height, currents, wind speed, surface topography, bathymetry, atmospheric temperature, precipitation and mapping of coastal vegetation. The main constraint is the development of reliable algorithms to transform scanned data to a true value. Semi-empirical relations and established co-variations between parameters, can be used to extract more information from sensors than their initial design goals. Examples of such derivative applications being the estimations of column production within finite geographical boundaries from surface chlorophyll images or nitrate data, which themselves are deduced from SST.

Usefulness of the Space Plan to the Coastal Module depends on two factors: improvements to algorithms and enlargement of the inventory of the parameters that can be remotely-sensed. We expect that the GOOS Coastal Module will support research in this direction in addition to collection of user-specific data as envisaged in its Terms of Reference. The ultimate objective of the Space Plan should be to develop robust operational predictive models from satellite inputs.

Sea Surface Temperature (SST)

A recently activated programme with NRSA, Hyderabad and C-MMACS, Bangalore is taking shape on the development of special algorithms for SST retrieval in the Indian Ocean using infrared data from NOAA AVHRR. A match-up data base consisting of cospatial and co-temporal satellite-sea truth data will be developed and used to develop new algorithms and to fine tune the coefficients of existing algorithms.

Ocean Colour

We are actively involved with the IRS P3 validation programme for parameter retrieval and atmospheric correction in collaboration with SAC, Ahmedabad. Ship cruises for the collection of sea truth data, off the west coast of India, synchronous with IRS P3 overpass are in progress now. Empirical algorithms specific to MOS channels will be developed for the estimation of chlorophyll and suspended sediments.

Ocean Surface Waves

At present in collaboration with SAC, Ahmedabad we are involved in the preparation of wind and wave climatology (wind speed, significant wave height, swell height) atlas for the Indian Ocean using the Altimeter data from GEOSAT, TOPEX/POSEIDON and ERS satellites for the period 1985-1995.

Winds

We are involved in a test programme, in collaboration with SAC, Ahmedabad to remove the ambiguity of wind directions derived from the ERS-1 scatterometer. The ERS-1 wind data obtained from SAC for the period July-August 1992 was compared with the wind data collected on board ORV Sagar Kanya during the same period. The 180 degree ambiguity in the wind direction of ERS-1 data was eliminated using a median filter. After removal of the ambiguity in wind directions, the wind vectors derived from ERS-I scatterometer have shown reasonably good agreement with ship board measurements.

Bathymetry

As a pilot project in collaboration with SAC, Ahmedabad, we are involved with the mapping of bathymetric features off the Goa coast using GEOSAT altimeter data. Results are encouraging.

AVHRR - Advanced Very High Resolution Radiometer
LISS - Linear Imaging and Self Scanning sensor
MSMR - Multi-frequency scanning passive microwave radiometer
MOS - Modular Opto-electronic Scanner
OCM - Ocean colour monitor
PMR - Passive Microwave Radiometer
TIM - Thermal Infrared Monitor
VHRR - Very High Resolution Radiometer
WiFS - Wide Field of View Sensor

APPENDIX

Currently operational Indian Satellites

Satellite	Date of Launch	Payload	Parameters
INSAT-2B (geostationary 94 E long.)	July 1993	VHRR Visible (2 km resolution) & 10-12 microns IR (8 km resolution).	Clouds, SST.
INSAT-2C (geostationary 74 E long,)	Nov. 1995	VHRR Visible (2 km resolution) & 10-12 microns IR (8 km resolution).	Clouds, SST.
IRS- lB (polar Sun sync.)	Aug. 1991	LISS-I (4 spectral bands visible & near IR with 72.5 m resolu- tion)	Land use, sediment load, shore line changes etc.
		LISS-II (4 spectral bands visible & near IR with 36.25 m resolution)	- d o -
IRS-lC (polar Sun sync.)	Dec. 1995	Panchromatic camera (spectral band 0.5-0.75 microns with 5,8 m resolution; revisit up to 5 days).	- d o -
		LISS-III (visible, near IR, short wave IR bands with 70.5 m& 23.5 m resolution).	- d o -

		WiFs (visible 2 bands with 1883 m resolution)	
IRS-P3 (polar Sun sync)	Mar. 1996	MOS (visible & near IR with 500 m resolu- tion)	Chlorophyll estimation, primary production.
		WiFS	

FUTURE INDIAN SATELLITES

Satellite	Date of Launch	Payload	Parameters
INSAT-2D (geostationary)	997	VHRR	Meteorology, SST.
OCEANSAT-I (polar Sun sync.)	997	OCM	Chlorophyll, primary production.
		MSMR	SST, wind speed
OCEANSAT-II (polar Sun sync.)	1998	OCM	Chlorophyll, primary production,
		Altimeter	wave height, sea surface topography.
		Scatterometer	wind speed and direction.
		PMR	SST.
		TIM	SST.

JAPAN

There are many debates on GOOS in Japan in the scientific approach among research bodies and in the implementation by operational segments. As the main objective of GOOS is to predict the ocean related to human activities, the first effort for GOOS will be to establish an observation system which will provide an efficient data set for numerical modelling.

In the scope of development of the numerical modelling for physical and bio-chemical oceanography and taking into account the difficulties of observations, physical oceanography will get the first priority.

One approach for GOOS in Japan is NEARGOOS, (the North East Asian Regional GOOS), a co-operative effort with China, Korea and Russia. The Ocean Research Institute of Tokyo University is providing a leadership for NEARGOOS. Tide gauge stations along the Sea of Japan, buoys in the Sea of Japan and the East China Sea and periodic cruises in these waters are contributions of Japan to NEARGOOS. The Japan Meteorological Agency (JMA) and the Japan Oceanographic Data Centre (JODC) are planning to provide data sets for NEARGOOS using the GTS system for real-time mode and other capabilities for delayed time mode.

The other approach for GOOS in Japan will be to combine some bilateral efforts with other countries for the process study of the Pacific Ocean. Scientifically, we are going to describe the Pacific Ocean in a clock-wise concept, starting from the El-Nines (or La-Ninas) over the Equator, to the Asia-Monsoon from the Indian Ocean to the Pacific Ocean along Asian countries, to the heat cap of the Arctic Ocean and to the eastern side of the Pacific Ocean. TYKKI (between Japan and the USA) has related programmes for process studies on this concept. Japan and Canada collaboration for science and technology also includes these process studies. There are also bilateral efforts with some Asian countries for the Asian Monsoon, including the Indonesia through-flow and the Kuroshio.

For the operative GOOS in the future we are convinced that we should start process studies over the Pacific Ocean with an intensive effort on numerical modelling of the ocean. As enormous efforts may be needed to upgrade the capabilities of process studies to the operational GOOS, it is urgent to deploy our possible capabilities including buoys, research vessels, satellites and new technology.

THE NETHERLANDS

In the Netherlands ‘EuroGOOS Netherlands’ has been established. It consists of a dynamic group of governmental agencies and commercial partners, namely Delft Hydraulics; the Advisory and Research Group on Geo Observation Systems and Services (ARGOSS); Electronic Data Systems (EDS); and the Oceanographic Company of the Netherlands (OCN) on the commercial side; and the Royal Netherlands Meteorological Institute (KNMI); the National Institute for Coastal and Marine Management (RIKZ); the Netherlands Geosciences Foundation (GOA); and Rijkswaterstaat’s North Sea Directorate on the government side. The first International Conference on EuroGOOS will be held from 7-11 October 1996 in the Hague, in the Netherlands.

Marine observations have been made routinely in the Netherlands for over 150 years. Presently there exists a North Sea network consisting of ten unmanned fixed locations equipped with automatic stations, which routinely measure a large number of parameters. The results are available to users in near real-time. On the global scale KNMI contributes to various satellite programmed and to the Voluntary Observing Ships (VOS) Programme of the World Meteorological Organization. On a regional scale KNMI contributes to the EGOS drifting buoy programme.

UNITED KINGDOM

The UK has established an inter-departmental sub-committee for GOOS and EUROGOOS which advises and reports to the Inter-Agency Committee for Marine Science and Technology (IACMST). During 1994-1995 IACMST supported an *ad hoc* working group to examine the UK involvement in GOOS and this working group recommended that a committee be set-up. The objective is to review and advise on UK continuing requirement for operational oceanographic data products in the general sense, including the role of GOOS and EUROGOOS for non-domestic scales,

Departments and Agencies are represented on the IACMST GOOS Sub-Committee at technical expert level. Agencies include fisheries (2), transport/shipping, environment, meteorology, navy, rivers/pollution and environmental research.

During 1995 IACMST produced an inventory of existing marine observations being carried out by UK agencies and universities in a routine and repeated or operational mode. The inventory excludes limited-time scientific experiments. The UK Meteorological Office and NERC usually provide the delegation to I-GOOS and the delegation is briefed by the IACMST-GOOS Sub-Committee. The UK Meteorological Office, Natural Environment Research Council and the Environment Agency National Rivers Authority are members of EUROGOOS. NERC hosts the EUROGOOS Office which is staffed jointly by NERC and IFREMER (France).

U.S.A.

Because of the short time available, it was not possible to present in any detail the U.S. activities contributing to GOOS. A summarizing table is presented at the end of this report.

As of February 1996, Eric Lindstrom has taken over as Director of the U.S. GOOS office. Mel Briscoe. has moved to a management position in the Office of Naval Research. The year 1996 also brought a paradigm shift in organization of US GOOS. Previously there was a view that many GOOS activities would occur by transformation of research activities to operational oceanography by “transfer” to the U.S. NOAA National Ocean Service (NOS). NOS is now leading on only the Coastal Module and other parts of NOAA and other agencies of the federal government will take the lead on GOOS modules for which they have the largest stake. NOAA remains the overall lead agency for the GOOS and the home of the Project Office.

There is also an emphasis in organizing U.S. GOOS to more closely align GOOS planning with ongoing discussion of national priorities and societal needs. This will, coincidently, better align GOOS with federal budget initiatives and offer new hope for funding under the U.S. GOOS banner. The U.S.A. is also pursuing bilateral agreements that will establish joint GOOS-related activities. Pacific Ocean studies are the subject of a bilateral with Japan (under the acronym TYKKI). The U.S. and France will discuss their joint work (tropical Atlantic observations, satellite altimetry, modeling, etc.) at a bilateral meeting in May 1996.

A summary diagram of U.S. GOOS (attached) shows that presently the U.S. is organizing its contributions under three general themes: Climate, Coasts, and Fisheries. Under Climate, the initial sub-themes are Seasonal to Interannual Climate Prediction and Sea-Level Rise. Under Coasts, there are three initial sub-themes; Ecosystem Management, Coastal Hazards, and Safe Navigation. The three coastal sub-themes will subsume (initially at least) significant portions of the HOTO and Services modules. A number of specific U.S. goals can be identified under the various sub-themes. Agency participation and identification of ultimate users and beneficiaries are also preliminary. A US annual report on activities related to GOOS is currently being compiled and a more comprehensive and accurate summary of U.S. activities will be presented at the I-GOOS planning session in May 1996.

US GOOS SUMMARY

International GOOS Modules	Initial U.S. GOOS Themes	Initial U.S. GOOS Sub-Themes	U.S. GOOS Specific Goals	Lead Agency and Partners	Ultimate Customers, Beneficiaries
Climate	Climate	Seasonal to Interannual Climate Prediction	•Continue Post-TOGA Pacific Ocean Observing System for ENSO Prediction	NOAA/OAR NOAA/OGP NOAA/NWS NOAA/NESDIS	Agriculture Water Resources Energy
		Sea Level Rise	•Monitor Global Absolute Sea Level	NASA/JPL NOAA/OGP NOAA/NOS	Coastal Planners/Managers Construction
Living Marine Resources	Fisheries	Sustainable Fisheries	•Monitor Large-scale Ecosystem Regime Shifts	NSF NOAA/NMFS DOE	Fishermen Fisheries Managers
Health of the Ocean	Coasts	Ecosystem Management (Land Use, Water Quality, Habitat)	•Monitor Coral Reef Ecosystem Changes •Monitor Land-based Sources of Pollution •Monitor Toxic Contaminants in Bivalves (Mussel Watch)	EPA NOAA/NOS State	Recreation Tourism Fisheries Managers Human Health
Coastal		Coastal Hazards	•Predict Toxic Algal Blooms	NOAA/NOS EPA NASA	Human Health Recreation Tourism
			•Forecast Coastal Erosion and Sediment Movement	USGS	Coastal Planners/Managers Construction Insurance Industry
Marine Services		Safe Navigation	•Increase Resolution of Models •Improve Coastal Forecasts	Navy/OCE NOAA/NOS NOAA/NWS	Marine Navigation Recreation Coastal Planners/Managers
			•Improve Observational Networks	NOAA/NWS NOAA/NESDIS	Marine Navigation Insurance Industry Recreation
			•Deliver Open Ocean/Coastal Data Products •Predict Ice Conditions	Navy/OCE NOAA/NESDIS USCG	

U.S.GOOS Project Office 4/17/96

This Table is a Work in Progress

ANNEX VI

WORKING GROUP REPORT ON MARINE METEOROLOGICAL AND OCEANOGRAPHIC SERVICES

By Johannes Guddal

1. SUMMARY

The GOOS Services Module (SM) has developed beyond the traditional marine meteorological scope of services, into typical physical, chemical, and even biological oceanographic products. This process has been governed by commercial market forces rather than organizational, scientific or political ones.

There is lack of international infrastructure and standards, and of strategies to meet the commercialization trends. There are inadequacies related to time/space coverage of measured data, - particularly on the global scale, but also in coastal zones and for sub-surface data in general.

There are cases of imbalance between costly measurement technology and the associated post-processing capabilities.

Better guidance is needed in the co-ordination of data and products in order to establish composite services, e. g, oil spill services, where wind, wave, current, etc. data are needed.

The more significant trends are:

(i) cross cutting of the SM into other GOOS modules;
(ii) market-forced developments comparable to, political/governmental;
(iii) increased use of coupled atmosphere/ocean models, and nested models;
(iv) exchange of updated numerical model tools in free or commercial domain, and vast availability of measurement technologies;
(v) a variety of marine users are being served, in particular within offshore industry and shipping, but also increasingly for coastal and port managements.

2. BACKGROUND

The working group on SM was established by Resolution I-GOOS-II.1 under the following terms of reference:

(i) Review existing marine, meteorological and oceanographic services and prepare a classification and summary review on the basis of criteria such as geographical location and coverage, type (data, nowcast, forecast, hindcast, etc.), parameters, user groups or applications, temporal coverage, etc.;

(ii) Collaborate with other ongoing review activities (e.g. those under EuroGOOS) to prepare a concise summary of user requirements, as well as data and information management, for marine meteorological and oceanographic services;

(iii) On the basis of these reviews, prepare an assessment of existing inadequacies in marine meteorological and oceanographic services (e. g. data availability, modelling capabilities, understanding of physical processes, product presentation, etc.);

(iv) Assess also development trends in existing marine meteorological and oceanographic services from the point-of-view of both service providers and users;

(v) Through the Chairman of the group, collaborate with and serve on the J-GOOS *ad hoc* group on the Services Module;

(vi) Provide a preliminary report for the consideration of I-GOOS-PS-II in mid-1996, and a final report for I-GOOS-III.

It was considered a necessary aid to the decision-making process on requirements for services development under GOOS to have an overview of existing services, user requirements, major deficiencies and development trends.

It was recognized that many of the benefits of GOOS for member states will occur through the provision of enhanced or new marine meteorological and oceanographic services, and that a large range of such services already existed.

3. WORK AND CONTRIBUTIONS OF THE GROUP

It was decided to review and classify services according to their descriptive parameters and to characteristics of the production line providing the final product to the end user.

Modes of the production line are along the abscissa of the corresponding table:

(i) description; nowcast, forecast, hindcast, area coverage etc.;
(ii) measurements, collection of data etc.;
(iii) Modelling and assimilation of data, forcing data;
(iv) value adding, presentation, distribution, formats etc.;
(v) the end user community, requirements, feedbacks, trends etc.

The spectrum (or “chain”) of services, ranging from marine meteorological variables through physical oceanographic to chemical/biological ones, was classified according to the IGOSS classification: surface meteorological, surface oceanographic and sub-surface oceanographic. In this context. we have taken the liberty to include such items as oil spills and algae blooms under “oceanographic”.

The tabular form (see Attachments) reflects the way of thinking within operational services where priorities are given according to “the voice of the market”.

4 OTHER REFERENCE MATERIAL

Other reference material that was considered relevant to the group work was:

(i) the final report of I-GOOS-II, Paris, June 1995, in particular the national reports on GOOS coordination and implementation activities;

(ii) IACMST Survey of UK Requirements for GOOS Data and Products, December 1993. by N. C. Flemming, director of EuroGOOS;

(iii) GOOS Status Report on Existing Ocean Elements and related Systems, December 1994. IOC/INF-992 ;

(iv) composition of IGOSS. May 1995. IOC/INF-998;

(v) scientific Design for the Common Module of GOOS and GCOS: “An Ocean Observing System for Climate”, OOSDP, March 1995;

(vi) towards Operational Oceanography: The Global Ocean Observing System (GOOS). (2nd Draft), I-GOOS/SSC-II/6.

These documents cover a wide range of GOOS aspects, the goals of the modules, related activities, regional arrangements supplementing global ones, technical/scientific matters and, not least important; user requirements. A comprehensive survey of user requirements have been done by EuroGOOS.

More elaborate documentation would have been requested on matters of data management and policy. Openness of data, on the regional and global level, is the most important aspect.

The “Climate”. “COZO”, and partly the “HOTO” modules are clearly cross-cut by the MM/O SM.

5. ANALYSIS OF INFORMATION

The primary documentation of the working group is the feedback from members, together with available national reports.

Complete questionnaire responses in tabular forms were received from 5 members, but other types of responses were in such forms that they were easy to interpret in terms of the major tasks set out in the terms of reference.

In total, the work of the group, combined with other reference material as mentioned above, gives basis for statements concerning the status and development trends for the Services module,

5.1 NATIONAL STATUS REPORT SUMMARIES TO I-GOOS-II

Australia has developed a significant level of interest at the technical level, with a number of recent initiatives with a view towards a broader GOOS. Difficulties are with the fiscal climate and the lack of a widely acceptable rationale for GOOS.

Brazil attributes high priority to the development of GOOS at the national level, mostly through programmes like IGOSS, GLOSS, IODE and DBCP.

Canada operates existing, although limited climate observing systems off its coasts. As international planning progresses, Canada could modify priorities in the interest and the overall climate module of GOOS. Canadian funding is uncertain.

Chile is implementing activities for TOGA, WOCE, GLOSS, IGOSS, IODE, JGOFS to be kept also as permanent systems for the future.

China operates longterm (from the 1950’s) ocean observing systems, and a great variety of services to customers.

Colombia has a comprehensive national plan, and cooperates through ERFEN, LOICS, IODE etc.,

Germany participates in IGOSS, IODE, WWW, BALTEX, WOCE etc.

India has a comprehensive national mechanism for GOOS implementation. A number of products are disseminated regularly.

Japan runs a wide spectrum of operational services as well as its own Space programme. There is a comprehensive contact to a number of user communities.

Malaysia is in the building process of a range of operational oceanographic services.

Malta participates in the MEDNET project which serves as a tool for information exchange in the Mediterranean.

Mauritius has core responsibilities within GMDSS and as member of WMP Marine Pollution Emergency Response Support System for its sea area.

The Netherlands operates a range of operational products and Services, and has a well known expertise in the field of coastal protection and coastal management.

Norway developed through the HOV project a range of operational services, most of which are now in the commercial domain.

Poland has a range of monitoring projects both at the Polish coast and in the Greenland Sea.

Russian federation is in the building process of a wide range of the Services Module.

Spain has mainly scientific activities, but there is a comprehensive coastal monitoring project for wave climate purposes, and this is user oriented.

United Kingdom has a wide range of operational Services.

United States of America has given priorities to observations for ENSO forecasts, coastal observations for red tides and algae bloomings, sea level observations, and coastal observations required for critical warnings. A wide range of oceanographical services exist.

Vietnam operates coastal and island hydrometeorological stations, and data are exchanged through WMO. There are daily marine weather forecasts, monthly hydrometeorological bulletins and other products serving the sea and island activities.

Several other nations are known to have started a GOOS Services Module.

Questionnaire responses from China, Japan, Malaysia, Norway and Russia give deeper information about the structure of their Services Modules. Although similar information would have been welcomed from other countries as well, there is reason to believe that much of the organizational philosophy is common, the different inadequacies are widely known as operational problems, most of them of practical nature. Trends in the development of the Services Module differ largely from country to country depending on given priorities and available funding. Following is a tabular summary of these responses.

Products	Status	Inadequacies	Trends
Surface meteorology	China: Regular met forecasting. Japan: Regular Malaysia: Forecasts Norway: Regular and user specified nowcast, forecast, hindscast. Russia: Global analysis, forecast, hindcast.	-- Malaysia: Need for ASEAN region atm. model. Norway: Needs for better geographical coverage of obs,. Russia: Wind reduction methods. Poor manual methods, Data quality, resolution and availability.	China: Large user community . Japan: Large variety of users Malaysia: Better user specification needed. Norway: increased interaction with end users. 'Russia: Increased use of coupled models atm. & ocean.
Surface oceanography	China: Analysis, forecast of waves, tides, ice, surge, SST. Hindcast of waves. Japan: Like China. Malaysia: SST measurements, wave forecasts tidal predictions. Oil drift model, Norway: Full range of services. Russia: Waves, current, surge/tide forecast/hindcast, MSL long term monitoring. Tsunami and harbour seiches warnings.	-- Malaysia: Need & lack of coastal current information. Need for better wind input to wave model. Need to upgrade wave model. Norway: Sparse data coverage, inadequate model resolution. Russia: Poor topographic data. Poor resolution of met. data in small areas etc.. Lack of physical under-standing on MSL and sea level data.	China: Ditto Japan: Ditto, large variety of distribut-ion systems. Malaysia: Wide marine user community, petroleum ind., shipping etc. Norway: Refinement of wave concept. Increased user interaction. New interest in short term (annual) climate predictions. Russia: Major trend to use nested grids. Trend to use hydrodynamic models for tidal predictions. Full wave spectra for harbour seiches.
Sub surface oceanography	Japan: Analysis of temperatures, Malaysia: Samples of temp., salinity, water quality, Norway: Sampling, monitoring, current forecasting and hindcasting. Russia: Temp./sal. profiles sampling and model assimi-lation. Forecasts. Sea ice forecasts. Oil slicks forecasts.	-- Malaysia: Needs more stations. Norway: Sparse data coverage, lack of verification on currents. Russia: Insufficient computer power. Decay of water quality network due to finances.	Japan: User in institutes, ships, publications, JMA. Norway: Interest depending on events, i.e. algae bloomings. Russia: To use coupled atm. and ocean models. Major trends to upgrade the systems technically and to enhance use of electronic means of comm. etc..

Aspects of data management and end user interaction have been mentioned only vaguely. There are, however, reasons to believe that operational oceanographic services also, like similar "pure" meteorological services, are subject to increased commercialization. Thus, the future of the GOOS Services Module, and implicitly the future of GOOS, depends not only on organizational, scientific and technological progress.

Indeed, a crucial element, which has not been addressed too frequently, will be the intellectual marketing of GOOS towards its target customers.

6 DISCUSSION AND CONCLUSIONS

6.1 DISCUSSION

There appears to be (at least) two different perceptions on the GOOS road towards operationality.

" Scientifically-anchored" communities foresee a longer term implementation of GOOS, carrying' with it still further modelling and scientific development and research. GOOS prospective work is emphasized, as well as "purer" oceanographic standards as related to meteorological standards. User requirements are paid much attention, however with little prospective to the potential ability to pay for end products.

Marine meteorological and oceanographic operational services, governmental and private, will claim that GOOS has already started say about 20 years ago, in the extreme pragmatic way *("give the customers what they want and can pay for, not tomorrow but today").* The range of services extend not only over the traditional physical oceanographic products, but beyond, into oil spill, water quality, algae blooms etc..

Numerical models and monitoring technology seem to set few barriers for establishing new services, since these are "transportable" and well documented.

It is also clear that the MM/O SM to a certain extent is market-driven, although the Governmental "market" is far from negligible.

Since most other modules rely on input of meteorological (MSLP and wind) data to drive their respective models, one see joint ventures between relevant MM services and oceanographic services, but also examples that the whole string of services is operated by the actual MM service agency alone.

6.2 CONCLUSIONS

6.2.1 Status

The GOOS Services Module is well underway in many ocean facing countries. The GOOS SM often functions as a "window" for other modules, in particular "Climate", HOTO and "Coastal". This means that customers used to obtain traditional marine meteorological products from operational services, address these same services for oceanographic products. MM/O services have listened to the market and followed up both on the model and the measurement side. There is comprehensive "sale and exchange" of models for wave, surge, current, oil spill etc.. This means that given the market, a system of forecasting can be established. Nowcast, forecast and hindcast are all included in many countries.

6.2.2 Inadequacies

Inadequacies are identified particularly at the global level of ocean monitoring of SST, ice and current. New user demands on requirements of seasonal and interannual predictions of the ocean environment cannot be met at the present stage.

Transportable methodologies are not widely available, Consensus of the global aspect is not reflected in present MM/O services. Data openness is still an unresolved problem.

More emphasis is needed to combine observations with first guess model results (J-COOS input). Applications of remote sensing have been developed but are not very visible in most MM/O products.

Measurement systems and their corresponding post-processing capacities are not always well "balanced", resulting in "blind" data accumulation with costly measurement technology, and for no end user purposes. This points to the need for better guidance on the total integration of data elements when constructing a composite service, e.g. oil spill prediction where wind, wave and current (and occasionally ice) information is needed.

User demands need also to be "awakened" for the COZO and HOTO modules.

6.2.3 Trends

The major trend is commercialization. This could at the end mean that establishment of the SM is governed by the needs of the market. This trend is already confirmed.

MM/O services are increasing in extension and volume; this means that services are provided for a range of oceanographic products in an ever growing number of areas and regions. Measurement technology and numerical models are widely available, both in the commercial and the free domain.

Regional GOOS organizations find their forms as necessary links between the global and the national levels, however with somewhat different emphasis on aspects of science, technology and infrastructure perception.

The voice of the end user will become louder, there is a challenge to learn how to listen to it and to organize services accordingly.

Meteorologically based activities (WWW, CMM, IGOSS,...) are indispensable to MM/O

7 RECOMMENDATIONS

It is recommended that SSC note the role of existing operational MM/O services concerning the GOOS road to operationality, and the apparent tendency that SM will act as a window for the "Climate", the "HOTO" and the coastal module.

It is recommended that SSC encourage GOOS implementers to listen to the market, to act pragmatically in terms of meeting the users needs.

An advisory body (probably within an existing working group) should be established with the following tasks:

- to overview available measurement technology, including feasibility, regularity. quality, prize and delivery conditions;

- to overview models and data available in the free or commercial domain;

- to advise on the co-ordination of elements needed to provide composite oceanographic services like oil spill predictions. To assess the need for a global web of data flow links needed for GOOS products to be obtained everywhere.

Finally, it is recommended that SSC assess the need of" intellectual marketing" of COOS products in order to ensure broader (non governmental) funding and the necessary data exchange. In particular, there are relevant international organizations representing marine users that should be approached for constructive future cooperation.

8 ATTACHMENTS

Five tabular questionnaire responses provided in the original document are not included here in this Annex.

ANNEX VII

REPORT OUTLINE TO J-GOOS OF GCOS ACTIVITIES

by Angus McEwan

Meeting in Hakone, October 1995

Very effective due to "Workshop" approach
Chair change: J. Houghton to J. Townshend

INTERSESSIONAL PROGRESS

Version 1.0 of: GCOS Plan

Space Based Observations
Data and Information Management
+ 7 reports, 2 newsletters, one brochure for Conference of Parties, FCCC

Current Status

Concentration on implementation
Some reduction in WMO resources, UNEP retreat, IOC reluctant
Concern on Climate Module implementation impeded by coastal emphasis
US push for Integrated Global Observing Strategy (IGOS)
Poor response to call by Secretary-General for establishment of national "focal points"

Space Plan News: New Chairman: John Morgan, former Director of EUMETSAT

7 missions
Prioritisation study by Smith System Engineering
Plan to CEOS for comment

Data and Information Management Plan (meets 14-17 May 1996 in D. F. O. Ottawa)

An "end to End" system
 Internet
 CD ROMS and diskettes
Pilot project by NOAA
Review of the state of data documentation (including oceanographic)

GCOS REVIEW OF IMPLEMENTATION ISSUES

Atmospheric Panel

Identified SST, upper ocean thermal content, sea ice as requirements for long-term and interannual monitoring
For CC Experiments, the above, plus deeper ocean.

Terrestrial Panel (met 19-22 March 1996 in Cape Town, South Africa)

Wants liaison with OOPC to define data products for biogeochemical cycles and seasonal and interannual assessments
Proposes a single GCOS/GTOS Data Panel.

Oceanographic Panel (Neville Smith report to J-GOOS on meeting of OOPC, 26-28 March 1996 in Miami)

No further review of OOSDP Report.

Next steps:

- Define useful products
- Assign priorities based on products for Users
- Consider importance/impact of river inputs, corals, etc., on C cycle
- Consider relativities between OOPC and UOP
- Consider WOCE quality assessment procedures in relation to GCOS ocean data
- Consider technical trade-offs in sampling.

Concern about effectiveness of IOC

- Need GSO support
- Weaknesses of IGCOS in implementation, therefore a critical role for GSO, GOOS Director, GSO mandate for implementation
- Close co-operation with GCOS

Centres for Data Assimilation

- Research community should be pragmatically regarded as a data source for the time being.
- GOOS Space Plan should be formulated consistent with GCOS Plan or integrated with it.
- GCOS push to resource the TAO Implementation Panel (TIP), and support IGOSS continuation of TOGA observations
- Stress IOC obligations to support GCOS
- Proposed- a joint meeting between AOP, OOPC and TOP on ocean climate requirements

Data Issues

- Address the question of a GCOS “label”
- Development of “Climate Indicators”
- Seek commonality with GOOS in concept, structure, data handling, sharing protocols, standards.

Other matters

- IGOS-GCOS to propose a pilot project?
- Recommendation for JPO with WWW, GAW, HWRP, GOOS and GTOS develop an approach to inventory existing observations.

ANNEX VIII

TERMS OF REFERENCE FOR THE HEALTH OF THE OCEAN PANEL (HOTO)

The HOTO Panel will be responsible for:

Ensuring a continuing up-dating of the Strategic Plan for HOTO to adequately reflect development and understanding arising through relevant research and technology.

Further analysing the nature of marine processes and vectors for human disease transmission to ensure that the most appropriate variables relating to threats to human health are included in the HOTO module design.

Developing specific HOTO module designs for several marine regions including spatial and temporal resolutions of sampling to test the validity and comprehensiveness of the Strategic Plan for HOTO and to determine the specific measurements/variables required from other modules/programmes to support HOTO measurements and their interpretation.

Designing plans for training, mutual assistance and capacity building, where necessary, for undertaking the regional assessments.

Exploring the means of integrating existing operational systems, both national and international, dealing with the health of the oceans for achieving the goals of GOOS.

Identifying both requirements, nature and availability of models that can facilitate interpretation of HOTO variables or allow prognostic prediction of potential/future conditions relating to Health of the Oceans.

Maintaining liaison with research and monitoring activities to ensure that assessments and predictions of the health of the oceans are based on sound and contemporary scientific knowledge; and

Co-ordination with other modules of GOOS for the purposes of ensuring compatible strategic and scientific development of all GOOS modules.

Developing interaction with other scientific and technical bodies having relevance to furthering the development of GOOS (i.e. ICES, PICES, EURO-GOOS, etc...)

Defining HOTO products relevant to the requirements of specific users and describing the procedures leading from the base variable measurements, through scientifically-proven interpretation, to the preparation of such products.

ANNEX IX

TERMS OF REFERENCE FOR THE J-GOOS LIVING MARINE RESOURCES (LMR) PANEL

Following recommendations from an *ad hoc* Panel for Monitoring and Assessment of the Living Marine Resources (LMR) Module of (GOOS) in December 1993, and the J-GOOS-SCOR LMR workshop of March 1996, J-GOOS decided to establish a formal scientific panel for the LMR module of GOOS with the following TOR.

The LMR Panel will be responsible for:

(i) The strategic development and detailed scientific and technical design of the observing system for the Living Marine Resources module of COOS.

(ii) Maintaining liaison with research and monitoring activities to ensure that assessments and predictions of the living resources of the oceans are based on sound and contemporary scientific knowledge,

(iii) Co-ordination with other modules of COOS for the purpose of ensuring compatible strategic and scientific development of all components of GOOS.

In particular, the LMR Panel should take the following actions as soon as possible:

(i) Identify the present and potential users of the data and products of a GOOS-LMR programme and ensure that the design and implementation of GOOS-LMR responds to these needs;

(ii) Specify the deliverables and products of GOOS-LMR to meet user needs. Where necessary, conduct surveys, workshops or other enquiries to establish which products are needed, and how the products may be delivered to users as rapidly as required;

(iii) Take into account the observation requirements of the other modules of GOOS in defining the LMR variables and observations needed, and stimulate numerical modelling and other studies to support the objectives of the LRM module with special attention to accuracy, calibration of observing procedures, quality control and spatial and temporal resolution of sampling.

(iv) Data sets required for the LMR Module should be specified in terms of:

(a) requirements for globally consistent data where relevant;
(b) standard methods for routine and repeated observations;
(c) cost effectiveness of different methods;
(d) recognition of observing systems already in place, nationally and internationally;
(e) data management systems needed to transmit, process and distribute data and information;
(f) necessary technology developments;
(g) utility for diagnostic and forecasting models.

(v) Assess the resulting availability of existing data relevant to GOOS-LMR, and ensure that these are properly archived and accessible to the user community.

(vi) Develop a plan for the design and implementation of an observing system which would provide the data required by LMR, consistent ‘with data provided for the general underpinning of GOOS and the data required by other modules. Variables and parameters should be selected with reference to their importance for:

(a) analysis of climate change;
(b) ecosystem and biodiversity changes;
(c) variations in primary productivity;
(d) variations in and renewable resources including fisheries.

(vii) The Panel should make recommendations concerning:

(a) the development and evaluation of methods for processing LMR data;
(b) protocols for the identification of significant trends and changes;
(c) techniques for monitoring;
(d) methods for data assimilation in diagnostic and prognostic models;
(e) mechanisms for distributing and archiving data sets;
(f) the promising directions for developing new ecosystem models,

(viii) Co-ordinate with other modules of GOOS for the purposes of ensuring compatible strategic and scientific development of all GOOS modules.

(ix) Integrate activities in developing coastal states, within the range of their capabilities. into the observing system and its operations and include regions where appropriate data have not been previously collected.

(x) Produce an outline draft plan or synopsis for presentation to J-GOOS-IV and Science Plan by late 1997.

ANNEX X

PROPOSAL TO JGOOS SPONSORS FOR INITIAL MEETING OF GOOS LIVING MARINE RESOURCES PANEL

submitted by James J. McCarthy

The third meeting of J-GOOS assigned to Professor James McCarthy the responsibility of identifying the membership and chair of a J-GOOS Panel for scientific planning and design of the Living Marine Resources Component of GOOS. It also adopted terms of reference for this Panel which call upon it to present a draft outline plan for LMR-GOOS to the fourth meeting of J-GOOS in April 1997.

Thus, a meeting of the LMR Panel will be required and should be held by March 1997 at the latest. Initial discussions at J-GOOS-III envisaged that the panel would comprise 10-12 members because of the range of scientific disciplines which must be addressed in order to deal adequately with the. responsibilities of the LMR Module.

The critical fields of endeavor which must be represented include:

Marine Ecology
Fish - especially larval biology
Zooplankton
Phytoplankton
Nutrients
Ocean Physics
Mathematical Modelling (2)
Observation systems - *in situ*
Remote sensing
Harmful Algal Blooms

Assuming a normal geographic distribution of the Panel membership, the site for the meeting should be selected to be as central as possible. Costs will be similar if it is held in Europe or on the east coast of the USA. I estimate a budget of $15,000-18,000 will be required to cover travel and per diems for 10-12 people for a three day meeting.

Staff support for this meeting needs to be negotiated with the sponsors of J-GOOS, in consultation with the Chair of the LMR Panel, and is estimated at 1.5 to 2 months of effort.

A second meeting with similar budgetary and staffing implications is anticipated in the intersessional period between J-GOOS-IV and V (i.e. in late 1997/early 1998).

ANNEX XI

SUMMARY OF AD HOC MEETING ON COASTAL MODULE PRECEDING J-GOOS-III

(22 April 1996)

1. It was recognised that the Climate, LMR and HOTO modules will include design aspects that extend to the coast. The CM will need to identify specific Coastal Zone processes not incorporated in the latter. These will include physical processes underlying the latter and also vital to the early phases of GOOS implementation.

2. It was envisaged that GOOS will include distinctive integrated observation systems applicable, respectively, in the coastal and oceanic regions. Enhanced predictability in the coastal zone will depend on:

- specifically focused satellite programmes;
- extension of in-situ and ship-borne monitoring networks based on instrumentation designed to common specifications;
- increased near-real time access to the latter.

3. Recognizing the urgent requirement for a design strategy relating to the above, it was decided to proceed with a Workshop this year, in Brisbane 29-31 July 1996 if the participation situation warrants, or at some other venue in the fall of 1996. Deliverables from this strategy to include:

(i) specifications for an integrated system design for coastal observations rationalised against end-user product development;

(ii) identification of common objectives related to GOOS including:

- quantification of shelf-edge exchanges
- global feed-backs
- atmospheric and terrestrial exchanges

(iii) Proposal for scientific initiatives (linked to IGBP, GLOBEC, etc...) to include "observational experiments", pilot studies to advance generic modelling component including related assimilation techniques.

Planning Considerations for CM Workshop 1996

1. Establish date and host institution with an eye on travel costs.
2. Assign responsibility for local arrangements.
3. Re-draft Straw Man Document:

- J-GOOS III to appoint working group

- Revised version to include conclusions from recent "Coastal" groups and to emphasize the contribution of the CM in facilitating GOOS objectives.

4. Establish list of potential participants (≈ 15) and, in addition to technical experts working in the field, consider representation from:

(i) other GOOS modules;
(ii) diverse geographical regions ;
(iii) EUROGOOS, US GOOS and NEARGOOS:
(iv) other disciplines including socio-economics.

ANNEX XII

SUMMARY OF OOPC-I

1. Met 25-27 March, RSMAS Miami. Guests included R. Molinari, R. Reynolds, M. Lefebvre, O. Brown, E. Lindstrom, T. Manabe, T. Spence. The principal agenda items were:

(i) a discussion of products and user needs and a strategy to bring the OOSDP OCOS design to this community;

(ii) a discussion of implementation issues surrounding (a) SST, (b) the ship-of-opportunity XBT program, (c) remote sensing, and (d) the priorities for GOOS document;

(iii) outlining a strategy for OOPC.

2. There was a brief discussion of the terms-of-reference. The OOPC would like to ensure that "ocean circulation" is seen to incorporate carbon; that explicit reference is made to "close" research groups, e.g. the CLIVAR UOP; and that operational (OOPC) vs research aims are clearer in the terms-of-reference.

3. User needs and products:

- Panel heard of the need to articulate the pathway from observations to beneficial products from many on the Panel, from the J-GOOS and GCOS perspective, and from many tasked with implementing the OOSDP Report.

- The Chair urged that the Panel, in the absence of alternative methods, must bring the OCOS (OOSDP Plan) to the users and implementors; we cannot wait for this to be done by others.

- The favoured strategy was to select key observation-to-product "lines" and produce illustrative documents demonstrating the value of those "lines". These documents (or perhaps preferably, electronic and printed glossy brochures) would be scientifically faithful to the OCOS design but would be in a form that would enable people "selling" the OCOS to explain exactly what it would provide (how and why), and be provided to agencies to encourage participation and provide them with (for internal use) easy-to-understand descriptions of where their contributions will lead and the benefits that will ensue. In the absence of experience in such activities, the OOPC will work on a few prototypes and interact with the targetted communities to test reaction to this idea. It will be important that the "lines" that are selected have real substance and are subject to few uncertainties (i.e. well tested research and application).

- The TOGA upper ocean network in support of operational climate prediction was chosen as the first case; several talks at OOPC I demonstrated that the lines from SOOP and TAO to operational climate prediction are now real and of some substance. The draft outline of such an end-to-end demonstration is attached.

SAMPLE OUTLINE OF END-TO-END DEMONSTRATION

I. ENSO MONITORING

Application:

El Nino monitoring and prediction: (the role of *in situ* ocean thermal data)

Target Users:

* National climate services
* International climate monitoring
* Agricultural sectors.

Benefits:

* Agriculture: improved planting/harvesting strategies.
* Local, national forewarning of changed likelihood of extreme conditions (government policy, insurance and energy industries).
* Scientific community.

N. B. The users here are the services; for each of the benefits listed above it was suggested that the end-to-end brochure would contain a suitable figure.

OOPC Strategy:

1. Observation network:

   (a) TAO Array
   (b) XBT Network
   (c) Communications

   [aside: wind stress, SST, Altimeter, in situ tide guages]
   Figure showing the platforms

2. The level-2 parameters:

   (a) Merged estimates of tropical Pacific thermal structure (Use figure with observation location superimposed; could use NCEP or BMRC; or JMA N. Pacific/137°E sections.

3. Initialization of coupled models:

   (a) Ocean models
   (b) Coupled model constraints (figure from BoM.

4. Model forecast:

   (a) NCEP forecast or from Experimental Bulletin?

5. Demonstration of how (2)-(4) are further developed for practical applications.

   (a) “map discussion”
   (b) SST forecast -> AGCM -> rainfall simulation.

6. Issues :

(a) Multivariate dependency on data (CLIVAR investigating)
(b) Model, data errors
(c) Translation of model forecast into something useful.

ANNEX XIII

BRIEFING MATERIAL FOR GOOS SATELLITE OBSERVATIONS

TOWARDS OPERATIONAL (SPACE) OCEANOGRAPHY

WHICH POLICY FOR DEVELOPING

A PERMANENT OCEAN OBSERVING SYSTEM?

M. LEFEBVRE

THIRD MEETING OF J-GOOS

PARIS, APRIL 23-25, 1996

OPERATIONAL OCEANOGRAPHY: WHY ?

- FEASIBILITY: MATURITY OF SPACE OCEANOGRAPHY
  - KEY TECHNOLOGIES DEMONSTRATED OR STABILIZED
  - KNOW-HOW, USE COMMUNITY DEVELOPED BY INTERNATIONAL RESEARCH PROGRAMMES (WOCE, CLIVAR, J-GOFS...)
    - INTEGRATION OF MODELS, IN-SITU/SPACE-BASED OBSERVATIONS
- VALUE/POTENTIAL OF APPLICATIONS DEMONSTRATED (ERS, T/P)
  - SUSTAINABLE SERVICES REQUIRE OPERATIONAL OBSERVING SYSTEM
- NEED FOR LONG TERM OCEAN MONITORING : GOOS, GCOS
  - OCEAN IS THE SLOW COMPONENT/MEMORY OF THE CLIMATE SYSTEM

QUANTITY TECHNIQUES PROVEN ON A PRE-OPERATIOAL, SYSTEMATIC BASIS

- INFRARED IMAGERY (AVHRR, ATSR) : SEA SURFACE TEMPERATURE
- DATA COLLECTION (ARGOS)
- ALTIMETRY (GEOSAT, ERS, TOPEX/POSEIDON)
  - WAVE HEIGHT/WIND SPEED, SEA LEVEL, TIDES, CIRCULATION, GEOD
- SCATTEROMETRY (ERS) : 2-D SURFACE WIND/STRESS FIELD (VECTOR)
- MICROWAVE IMAGERY (SSM/I) : 2-D SURFACE WIND FIELD (SPEED)
- SAR IMAGERY : SEA ICE MONITORING

TECHNIQUES UNDER ASSESSMENT

- MICROWAVE IMAGERY : RAIN RATE/FRESH WATER FLUX , SST
- OCEAN COLOR: DEMONSTRATION AWAITS SEAWIFS/OCTS/MODIS/MERIS
- SAR IMAGERY (J-ERS, ERS, RADARSAT)
  - SPECTRAL SIGNATURES OF OCEAN WAVES (GEOMETRY-DEPENDENT)
  - POLLUTION MONITORING (CONDITION-DEPENDENT, REVISIT FREQ. ?)
  - LOCAL SIGNATURES OF EDDY CIRCULATION AND AIR-SEA INTERACTIONS
  - BATHYMETRY...

TECHNIQUES TO BE DEMONSTRATED

- MULTI-POLARIZED MICROWAVE IMAGERY : SURFACE WIND VECTOR ?
- VERY LOW FREQUENCY- MICROWAVE IMAGERY : SALINITY ?
- CONICAL SCAN, REAL APERTURE RADAR : WAVE SPECTRUM

APPLICATIONS OF WIND/WAVE OBSERVATIONS (ALT, SCAT, SSM-I, SAR)

- MARINE NOWCASTING AND SEA STATE PREDICTION
  - SECURITY AT SEA, NAVIGATION, SHIP ROUTING
  - DIRECT USE (NOWCASTING) OR ASSIMILATION INTO MODELS
- WIND/WAVE STATISTICS
  - DESIGN/SIZING OF OFF-SHORE/COASTAL INFRASTRUCTURES
  - PLANNING/OPTIMIZATION OF OFF-SHORE OPERATIONS
- FORCING FUNCTION/BOUNDARY CONDITIONS FOR OCEAN MODELS
  - GRIDDED FIELDS FROM OPERATIONAL DATA ASSIMILATION IN NWP
  - PROPAGATION TO THE SHORE

MESOSCALE CIRCULATION (ALTIMETRY, IR IMAGERY)

- MONITORING AND PREDICTION
  - SHIP ROUTING
  - OFF-SHORE OPERATIONS IN ENERGETIC AREAS (EG GULF OF MEXICO)
  - ACOUSTIC PREDICTION
- FORCING/BOUNDARY CONDITIONS FOR COASTAL MODELS
  - SEMI-ENCLOSED SEAS : MEDITERRANEAN SEA
  - TRANSPORT OF POLLUTANTS/NUTRIENTS
  - DYNAMICS AND ECOSYSTEMS
- PERSPECTIVE : BASIN SCALE CIRCULATION/NESTED MODELS

CLIMATE, CIRCULATION AND SEA LEVEL (ALTIMETRY, IR IMAGERY, SCATTEROMETRY)

- **CLIMATE RESEARCH, MONITORING AND PREDICTION**
  - EARLY DETECTION/PREDICTION OF EL NINO EVENTS
    - DIAGNOSTIC, VALIDATION, INITIALIZATION OF PREDICTIVE MODELS
  - MONITORING/PREDICTION OF SEASONAL/INTERANNUAL VARIABILITY
    - BASIN SCALE FLUCTUATIONS (OCEAN-ATMOSPHERE-ICE INTERACTION)
    - SEASONAL PREDICTIONS : COUPLED MODELS WITH ASSIMILATION
  - MONITORING OF MEAN SEA LEVEL VARIATIONS (TP-CLASS ALTIMETRY)
  - ROLE OF OCEAN IN CARBON CYCLE: TRANSPORT OF DISOLVED CARBON

GLOBAL SCALE REQUIREMENTS : WORLD OCEAN WATCH

- **GLOBAL-SCALE REQUIREMENTS FOR GOOS : "WORLD OCEAN WATCH"**
  - DATA COLLECTION : ARGOS
  - TWO DUAL-SWATH SCATTEROMETERS (FOR PROPER SAMPLING)
  - TWO RADAR ALTIMETER MISSIONS WITH AT LEAST ONE TOPEX CLASS
    - SPECIFIC ORBITS, DEDICATED SYSTEMS FOR MISSION OPTIMIZATION
  - SEVERAL INFRARED IMAGERS FOR SST MAPPING
  - TWO OCEAN COLOUR IMAGING MISSIONS

  (POSSIBLE ADDITIONS : IMAGING MW RADIOMETERS, SAR...)

OCEANOGRAPHY IN THE COASTAL ZONE : ISSUES

- **VARIETY OF POTENTIAL APPLICATIONS/BENEFITS**
  - ENVIRONMENT, COASTAL ENGINEERING/MANAGEMENT, FISHERIES, NAVIGATION CONTROL...
- ***COMPLEX USER/CLIENT COMMUNITY***
  - RESPONSIBILITIES SHARED AMONG A GREAT VARIETY OF PLAYERS
  - ACTIVE PRIVATE SECTOR
- **REQUIREMENTS**
  - LOW BIT RATE DATA FOR BOUNDARY CONDITION/PROPAGATIVE PATTERNS
  - MEDIUM/HIGH RESOLUTION IMAGERY (EG SAR...)
    - POLLUTION DETECTION , ALGAE BLOOMS, TRAFFIC MONITORING

↳ DEDICATED SYSTEMS OR MULTIPURPOSE MISSIONS ?

↳ INTEGRATION AND VALUE OF SPACE MEASUREMENTS : COST/BENEFIT ?

POSSIBLE GUIDELINES FOR IMPLEMENTATION

- SYSTEM VIEW : ALL INFORMATION SOURCES TO BE CONSIDERED
- INCREMENTAL :
  - UPGRADING/EXPANSION OF MET SYSTEMS : "DUAL" APPROACH
    - ↳ METOP, US CONVERGED SYSTEM ?
  - LOW COST SYSTEMS FOR SPECIFIC ADDITIONAL CAPABILITIES
    - AFFORDABLE TO CONSORTIA OF ORGANIZATIONS/INVESTORS
    - ↳ SMALL SATELLITES PROMISING FOR THE MOST SPECIALIZED MISSIONS
- MAXIMUM USE OF MULTIPURPOSE IMAGERY SYSTEMS
- FEDERATION OF INTERESTS AND LEADERSHIP

BACKGROUND (1/2)

- VERY FEW COMMITMENTS TO OPERATIONAL SYSTEMS/SERVICES
  - HIGH RESOLUTION MULTIPURPOSE IMAGERY (SPOT, LANDSAT, RADARSAT)
  - METEOROLOGICAL GEO/POLAR SYSTEMS (CGMS)

  ↳ STRONG JUSTIFICATION NEEDED FOR A NEW OPERATIONAL LINE

- NATIONAL INTEREST VARYING AS A FUNCTION OF :
  - ECONOMY (FISHERIES, NATURAL RESOURCES, NAVIGATION ...)
  - ENVIRONMENT (EG SENSITIVITY TO STORM SURGES, POLLUTION...)
  - ...

  ↳ IMPACT ON POTENTIAL INVOLVEMENT/INVESTMENT/LEADERSHIP

BACKGROUND (2/2)

- COMMONALITY WITH METEOROLOGY : AIR/SEA INT., MARINE METEOROLOGY
- USER/FUNDING ORGANIZATIONS
  - METEOROLOGICAL OR "DUAL" (EG NOAA)
    - BUDGET GROWTH DEDICATED TO CONSOLIDATION & EVOLUTION OF CURRENT SYSTEMS
  - VERY FEW OTHER OPERATIONAL ORGANIZATIONS
- VARIOUS JUSTIFICATIONS FOR PROGRAMMES : "VALUE FOR MONEY"
  - ECONOMIC RETURN
  - GUIDANCE FOR FUTURE POLICY/STRATEGIC DECISIONS
  - SCIENCE/RESEARCH

  ↳ FEDERATION OF INTERESTS/SHARING OF RESOURCES DESIRABLE

  ↳ TAKE ADVANTAGE OF OPPORTUNITIES

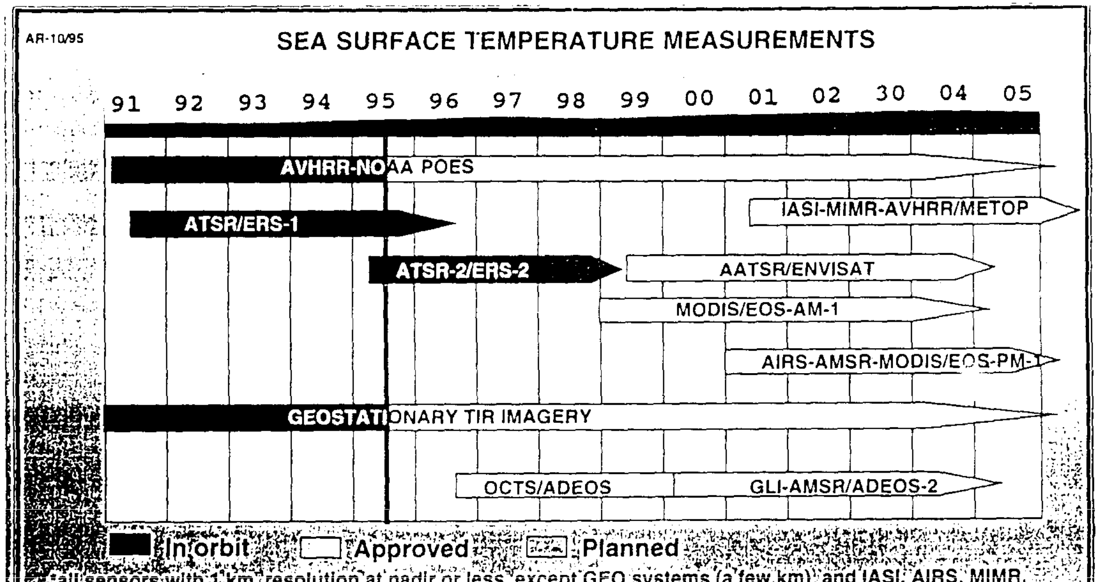
KEY OPPORTUNITIES

- SCATTEROMETRY ON METOP
- OCEAN SENSORS ON US CONVERGED SYSTEM ?
- CONTINUE ADEOS SERIES (LOW RATE OCEAN IMAGERY) BEYOND ADEOS-2 (SEA-WINDS, AMSR, GLI/POLDER) ?
- SPECIALIZED, LOW COST SMALL SATELLITE MISSIONS
  - ALTIMETRY : TPFO
  - OCEAN COLOUR (SEAWIFS-TYPE)
  - SCATTEROMETRY (BACK UP TO METOP ?), ROWS ? , COASTAL IMAGERY ?

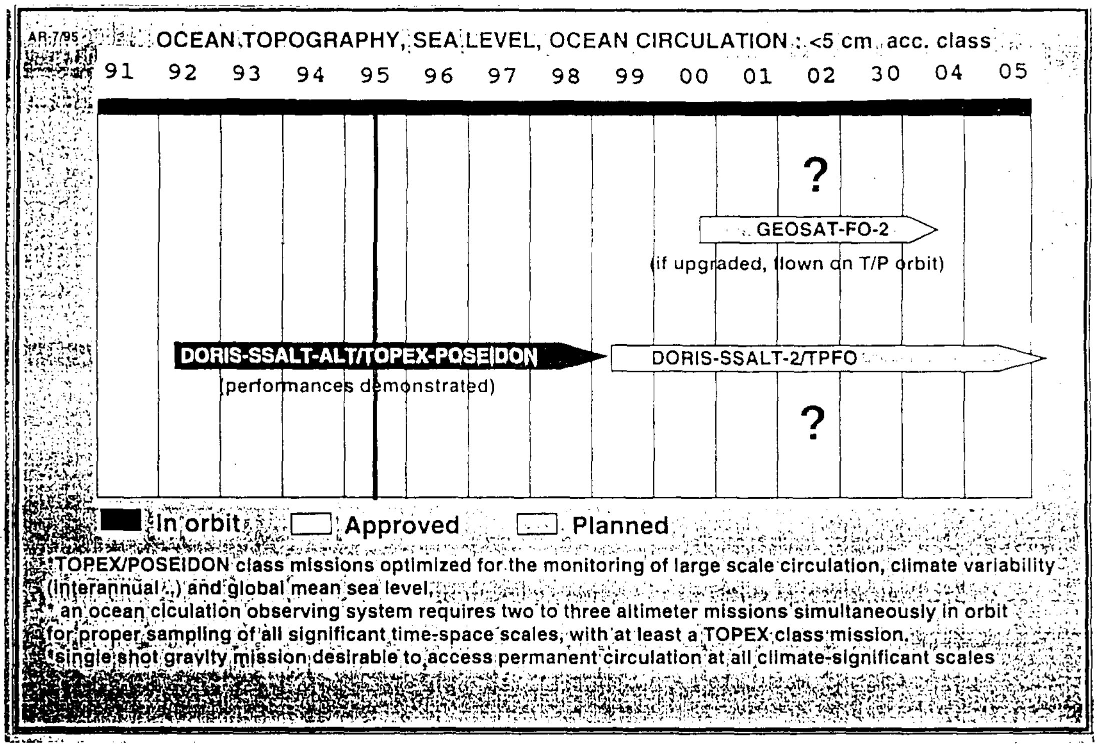
ANALYSIS OF CURRENT SPACE PROGRAMMES

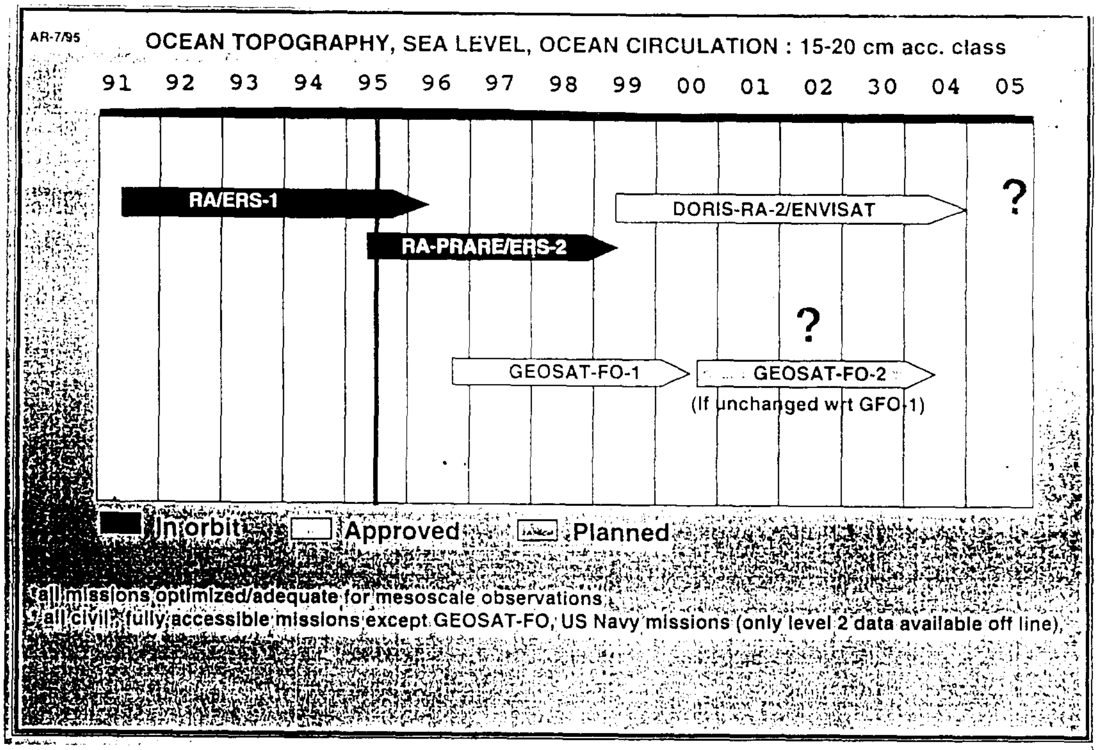
- MAJOR GAPS IN THE SHORT TERM :
  - ONE SCATTEROMETER LINE MISSING AFTER ERS-2 (1999-2000)
  - NO HIGH PRECISION ALTIMETRY MISSION BEYOND TOPEX (1999)
- CONCERNS FOR THE MEDIUM TERM :
  - CONTINUITY OF OCEAN COLOUR MEASUREMENTS
    - AFTER ADEOS-2, ENVISAT, EOS-AM1/PM-1

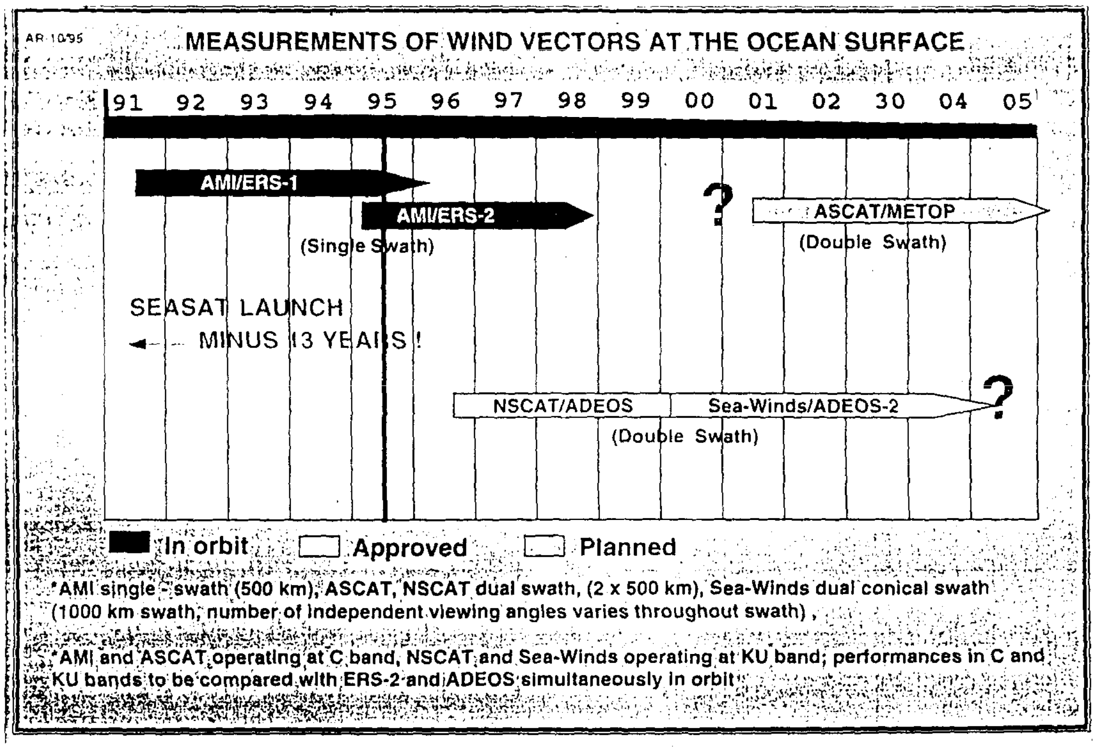
  MW IMAGERY IN THE AFTERNOON ORBIT
    - BEYOND EOS-PM1
  - CONFIGURATION/CONTINUITY OF ALTIMETER SYSTEM
    - BEYOND GFO1 AND ENVISAT

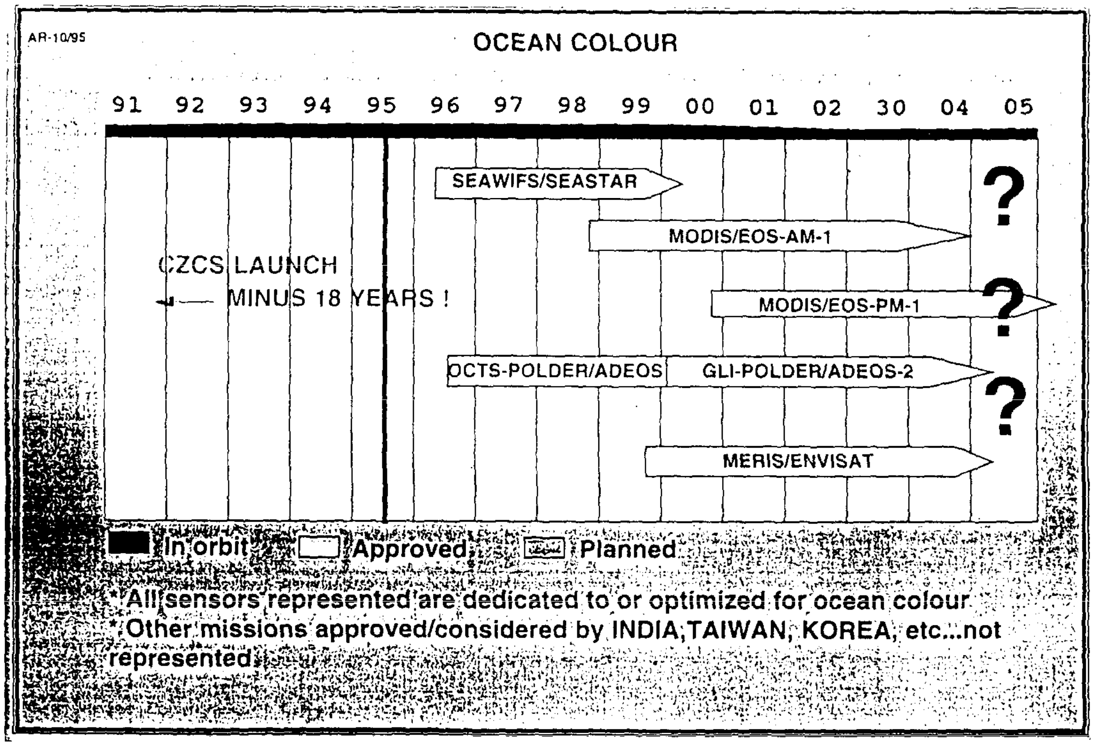


- all sensors with 1 km resolution at nadir or less, except GEO systems (a few km), and IASI, AIRS, MIMR, AMSR (some 10 km)
- SST primary objective of (A)ATSR(2); other sensors multipurpose; absolute accuracy of GEO systems and microwave radiometers lower; to be documented
- all sensors wide-swath (eg 2000 km) except (A)ATSR (2)(450 km)
- Impact of US convergence TBD

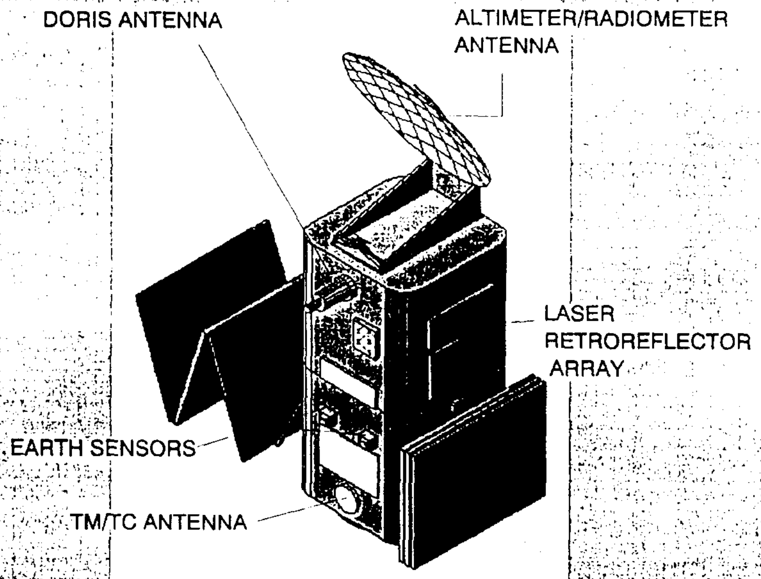

AR-7/95
OCEAN TOPOGRAPHY, SEA LEVEL, OCEAN CIRCULATION : <5 cm acc. class
91 92 93 94 95 96 97 98 99 00 01 02 30 04 05
?
GEOSAT-FO-2
(if upgraded, flown on T/P orbit)
DORIS-SSALT-ALT/TOPEX-POSEIDON
(performances demonstrated)
DORIS-SSALT-2/TPFO
?
In orbit
Approved
Planned
TOPEX/POSEIDON class missions optimized for the monitoring of large scale circulation, climate variability (interannual..) and global mean sea level,
an ocean ciculation observing system requires two to three altimeter missions simultaneously in orbit for proper sampling of all significant time-space scales, with at least a TOPEX class mission.
single shot gravity mission desirable to access permanent circulation at all climate-significant scales


AR-7/95
OCEAN TOPOGRAPHY, SEA LEVEL, OCEAN CIRCULATION : 15-20 cm acc. class
91 92 93 94 95 96 97 98 99 00 01 02 30 04 05
RA/ERS-1
DORIS-RA-2/ENVISAT
?
RA-PRARE/ERS-2
?
GEOSAT-FO-1
GEOSAT-FO-2
(If unchanged wrt GFO-1)
In orbit
Approved
Planned
all missions optimized/adequate for mesoscale observations
all civil, fully accessible missions except GEOSAT-FO, US Navy missions (only level 2 data available off line),


AR 10/95
MEASUREMENTS OF WIND VECTORS AT THE OCEAN SURFACE
91 92 93 94 95 96 97 98 99 00 01 02 30 04 05
AMI/ERS-1
AMI/ERS-2
(Single Swath)
?
ASCAT/METOP
(Double Swath)
SEASAT LAUNCH
MINUS 13 YEARS !
NSCAT/ADEOS
Sea-Winds/ADEOS-2
(Double Swath)
In orbit
Approved
Planned
*AMI single swath (500 km), ASCAT, NSCAT dual swath, (2 x 500 km), Sea-Winds dual conical swath (1000 km swath; number of independent viewing angles varies throughout swath)
*AMI and ASCAT operating at C band, NSCAT and Sea-Winds operating at KU band; performances in C and KU bands to be compared with ERS-2 and ADEOS simultaneously in orbit


AR-10/95
OCEAN COLOUR
91 92 93 94 95 96 97 98 99 00 01 02 30 04 05
SEAWIFS/SEASTAR
?
MODIS/EOS-AM-1
CZCS LAUNCH
MINUS 18 YEARS !
MODIS/EOS-PM-1
OCTS-POLDER/ADEOS
GLI-POLDER/ADEOS-2
MERIS/ENVISAT
In orbit
Approved
Planned
*All sensors represented are dedicated to or optimized for ocean colour
*Other missions approved/considered by INDIA, TAIWAN, KOREA, etc...not represented

TPFO SATELLITE : CANDIDATE CONFIGURATION



TOPEX/POSEIDON VERSUS TPFO/PROTEUS

TOPEX POSEIDON		*TPFO/PROTEUS*
	MASS	
2. 5 TONS		450 KG (20% MARGIN INCL.)
	POWER	
900 W		350 W (20% MARGINS INCL.)
	ERROR BUDGET (LOCAL, INSTANTANEOUS)	
< 4.7 cm (RMS)/2 cm targetted		< 4.7 cm (RMS)/2 cm targetted
	RECURRING COST (SATELLITE ONLY)	
NOT APPLICABLE		50 M$/200 MF (IE ANNUAL FRENCH CONTRIBUTION TO EUMETSAT)

ANNEX XIV

THE IOC REMOTE SENSING PROGRAMME

submitted by John Withrow

The IOC Remote Sensing program derives its requirements for remotely sensed data from the panels of GOOS. At this time there are just two panels that have generated such requirements: the Climate Panel and the Services Panel. The requirements developed by these panels are reviewed by the GCOS Data Panel in the case of Climate and the Joint CMM/IGOSS/IODE Sub-Group on Oceanic Satellites and Remote Sensing (OSRS) in the case of both climate and services. The OSRS is unique in that it also reviews and provides information on all forms of electromagnetic remote sensing including not only satellites but also aircraft and ground based radars. It is important to note that the review does not include the scientific justification which is the purview of the panels but only the technical aspects of the requirement. There may in fact be requirements that cannot be met with todays technology but whose technology is in the formative stages and the need for which must be justified. Once the requirements have been reviewed they are submitted to the satellite agencies through groups such as the Committee on Earth Observation Satellites (both IOC and GOOS are affiliates), the Coordinating Group on Meteorological Satellites and on an individual basis through National representatives.

Ocean Color

International cooperation in satellite ocean color remote sensing of the global and coastal /oceans is very timely owing to the large number of sensors planned for launch over the next 10 years. This cooperation will save money and produce the best possible local, regional and global data products to study daily the interannual changes and trends in the biological characteristics of coastal and open ocean waters.

The two principal strategies of the cooperative program envisioned here are to maintain continuity of key observations across multiple satellite sensors at the most important wavelengths, while at the same time promoting enhanced capabilities as more advanced sensors come on line. An important component of this program is to develop protocols for calibrating sensors and developing relationships among national standards of all cooperating countries, Such a program will ensure high quality data into the future to study basic scientific questions and to provide information to the practical decisions for managing the ocean environment and its renewable resources.

Another important component of an international program is to develop and refine programs and protocols for in situ calibration and validation (cal/val) programs, as well as protocols for exchanging these data. In situ cal/val programs may involve countries who are not flying ocean color instruments, but who are interested in developing their own local applications, Internationally coordinated cal/val programs are valuable even if only one sensor is flying, since regional variations in bio-optical characteristics are significant and must be known for broadest possible applications of ocean color imagery.

In order to facilitate and implement the activities described above the IOC Ocean Colour Data Utilization and Requirements Workshop (Sidney, Canada, 21-22 September 1995) recommended the formation of an international expert group. The group subsequently called the International Ocean Color Coordination Group was formed by IOC and endorsed and supported by the Committee on Earth Observation Satellites (Montreal, 13-15 October 1995). This group will serve as a focal point for International Ocean Colour Activities. The Group held its first meeting in Toulouse (22-23 March 1996) focusing on ocean color calibration and validation which is viewed as a key near-term activity area.

ANNEX XV

SUMMARY FOR J-GOOS OF THE *AD HOC* CEOS WORKING GROUP MEETING ON THE INTEGRATED GLOBAL OBSERVATION STRATEGY (IGOS)

(Seattle, 27-29 March 1996)
submitted by Geoffrey Holland

Introduction

The meeting was chaired by Brian Embleton (Australia), the Chairman of CEOS, and attended by a large number of space agencies and affiliates. In his opening remarks, the Chairman indicated the objective of the meeting was to respond to the generally held view that an increased co-ordination was required between the user community and among the various elements of global observing systems. He traced the history of the initiative from the Montreal CEOS plenary in 1995 to the present meeting, from which he hoped recommendations on the space-based elements would be forthcoming to the CEOS plenary meeting later in the year. He noted also the importance of the complementary in situ meeting, planned for September, to look at the surface based contribution to a possible IGOS.

The agenda allowed for a presentation of a synthesis of the views expressed by interested parties on the subject of an IGOS and received in response to a questionnaire distributed before the meeting. Although the participation at this meeting and by correspondence 'was very representative, he observed that some CEOS members and affiliates had not yet responded and therefore the Seattle meeting recommendations would need to be vetted by the complete community. He was looking for answers to the following questions:

(i) is there a consensus that IGOS is sensible and feasible?
(ii) what recommendations can be made to CEOS?
(iii) can we contribute to the *in situ.* meeting?

The Debate

Several useful presentations were made to provide the initial background for the discussions. Some interesting points emerged from these, such as the advanced domestic position of some countries, such as Japan, in their thinking and national framework in response to a co-ordinated observations strategy. The sensitivity of the WMO to any system that might challenge or interfere with what they see as an existing satisfactory system of space and *in situ* elements in the World Weather Watch was apparent throughout the discussions. In contrast, the ocean community, with it own absence of operational observing systems, had much to gain from this dialogue with the space-borne observing community. The land-based segment was probably the least mature of the three areas in terms of observational design.

One presentation covered the *in situ* meeting planned for 11-13 September 1996, in Geneva. The meeting has been called to assess the status of *in situ* observations, to develop a strategy to improve this status and to consider the place of *in situ* observations within an IGOS. The meeting is being organized by the GCOS Secretariat in the context of addressing the CEOS initiative, and also the problems of declining observations and budgets. Another related GCOS initiative was the suggestion to form an advisory group from GCOS, GAOS, GOOS and GTOS to look at the co-ordination of space-borne requirements, many of which, for example, in data relay, and the multiple use of some sensors could be mutual.

The debate on all four categories was initiated in plenary and followed up on the last day by individual drafting groups that reported their findings to the full meeting for final acceptance. A report based on these discussions will be prepared by the organizing committee.

1. THE NEED FOR AN IGOS

There was a consensus of all participants that the concept of an IGOS was reasonable and necessary. Several speakers referred to their satisfaction that the IGOS was a "Strategy" rather than a

"*System*", thereby providing a framework for co-ordination rather than an additional competing programme structure. *Inter alia* it was noted that the primary objectives for an IGOS were to address global issues, national economic and social development, improved management and conservation of the environment, better scientific understanding and through the co-ordination an overall cost-effectiveness. It was recognized that the fundamental drivers of an IGOS would be national priorities and budgets, but that the results from an IGOS would yield benefits, even to national requirements.

It was recommended that CEOS support the development of the space-borne component of an IGOS.

The need for a high-level political acceptance of the need for an IGOS was recognized and that support should be pursued in individual nations and international agencies, in terms of the space component.

2. DEFINING THE CHARACTERISTICS OF AN IGOS

It was generally agreed that the definition and priorities for an IGOS should be driven by the client community, based on clearly defined and stated requirements. In this regard CEOS should be prepared to assist users who are not well organized to respond. The research community should be accommodated. The IGOS should provide a mechanism, outlining responsibilities and roles, allow for an on-going dialogue and the identification of problems at an early stage. Commitments should be negotiated, but would be voluntary in character.

The IGOS would build on existing mechanisms and experience, should cover both space and surface observation programmes, be a vehicle for discussions on common elements, such as data management and delivery and provide the means to negotiate cost-effective solutions to requirements.

With regard to data, the need to rationalize data policies was recognized as well as the common requirement to satisfy coherent and disparate user communities with data from the various components of observations systems.

Implementation

The preparation of a strategy for the space component of the overall IGOS will require the establishment of a group. Once defined the implementation of the space component in response to the strategic direction will need to be addressed. The first iteration of an examination of requirements and planned space programmes will be tackled by a CEOS Task Force which will report in September 1996.

It was considered unrealistic to attempt to condense all priorities from all users into a single priority list. Difference space agencies will not doubt wish to examine priorities and make judgements based on their own priorities and capabilities. Priorities should therefore outline the opportunities for action, results, benefits and possible cost effectiveness,

A strategy will enable an optimum number of needs to be met with the resources available.

The possibilities of initial or pilot programmes were discussed, with ocean colour being one of such area. I presented ocean colour as a potential thematic example for a pilot project, being global in character and not being possible to fulfil without a co-ordinated effort on the part of both space and surface-based observations. I also noted that other pilot programmes to investigate the value of an IGOS to he improvement of a mature operational system (WWW) and an issue oriented multidisciplinary and multi-user study (climate) could also be usefully considered.

The meeting recognized that the CEOS forum was one of the key places where an lGOS dialogue could be initiated, because of the presence of both space borne members and the surface-based affiliates. To be successful the various interests in IGOS will try to move from a collection of contributions to a collective contribution.

Caution was expressed from many sides as to the need for a realistic time-schedule, a manageable programme, realistic expectations and negotiated commitments. There was no agreement on discrete first steps to be undertaken, however, several participants did mention ocean colour as being an on-going and useful example of co-operation.

Some ideas for structure were discussed but no firm conclusions reached.

Actions

The final discussion category was "next steps", some of which were administrative in character.

(i) A draft report of the *ad hoc* meeting will be prepared by the Rapporteur and organizing committee and distributed to participants for comment prior to release to the full CEOS membership. The timetable for completion of this exercise is the end of May.

(ii) The final report will also be made available to the organizers of the *in situ* meeting.

(iii) CEOS representatives will be invited to the *in situ* meeting,

(iv) The organizing committee for the Seattle meeting will continue in order to facilitate co-ordination with the *in* situ meeting and the completion of input into CEOS.

(v) After the *in situ* meeting the respective organizing committees will meet to discuss the possibilities of co-operative action.

(vi) Proof of concept candidates still require discussion and agreement.

(vii) The IGOS concept should be discussed amongst national entities to ensure a coherent view in the various fora.

(viii) The co-operation with the proposed GXOS group should be explored.

(ix) Possibilities of requirements arising from the recent spate of international conventions and agreements must be investigated.

ANNEX XVI

GLOSSARY OF ACRONYMS AND SPECIAL TERMS

ACSYS	Arctic Climate Study System
ADBP	Arctic Drifting Buoy Programme
ALACE	Autonomous Lagrangian Circulation Explorer (float)
ARGOS	Satellite Data Collection and Location System
BT	Bathythermograph
CAS	Commission on Atmospheric Sciences
CEOS	Committee on Earth Observation Satellite
CLIVAR	Cimate Variability and Predictability Programme
CM	Coastal Module (of GOOS)
CMM	Commision for Marine Meteorology
CTD	Conductivity Temperature Depth Instrument
CZ	Coastal Zone
DBCP	Data Buoy Cooperation Panel
ENSO	El Nino Southern Oscillation
ESA	European Space Agency
EU	European Union
EuroGOOS	European GOOS
FAO	Food and Agriculture Organization (of the UN)
FCCC	Framework Convention on Climate Change
FGGE	First GARP Global Experiment
GARP	First GARP Global Experiment
GCOS	Global Climate Observing System
GEF	Global Environment Facility
GEWEX	Global Energy and Water Cycle Experiment
GLOBEC	Global Ocean Ecosystems Dynamics
GLOSS	Global Sea Level Observing System
GOOS	Global Ocean observing System
GTOS	Global Terrestrial Observing System
GTS	Global Telecommunications System
HOTO	Health of the Ocean (Module of GOOS)
I-GOOS	Intergovernmental Committee for GOOS
ICES	International Council for the Exploration of the Seas
ICSU	International Council of Scientific Unions
IGBP	International Geosphere-Biosphere Programme
IGO	Intergovernmental Organization
IGOSS	Integrated Global Ocean Services System
IHDP	International Human Dimensions Programme
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data and Information Exchange
J-GOOS	Joint GOOS Scientific and Technical Committee
JGOFS	Joint Global Ocean Fluxes Study
JSC	Joint Scientific Panel (of the WCRP)
LME	Large Marine Ecosystems
LMR	Living Marine Resources
LOICZ	Land-Ocean Interaction in the Coastal Zone
NE	Numerical Experiment
NEARGOOS	Northeast Asia Regional GOOS
NEG	Numerical Experiment Group
NGO	Non-Government Organization
OCA/PAC	Ocean and Coastal Areas Programme Activities Centre 1
OOPC	Ocean Observations Panel for Climate
OOSDP	Ocean oberving System Development Panel
OSE	Oberving System Experiment

OSSE	Oberving System Simulation Experiment
PALACE	Profiling ALACE Floats
PICES	North Pacific Marine Sciences Organization
QC	Quality Control
ROSCOP	Report of Observations/Samples Collected by Oceanographic Programmes
SCOPE	Scientific Committee on Problems of the Environment (of ICSU)
SCOR	Scientific Committee on Oceanic Research
SM	Services Module (of GOOS)
SSC	Strategy Sub-Committee (of I-GOOS)
TAO	Tropical Atmosphere Ocean
TOGA	Tropical Ocean Global Atmosphere Programme
TOR	Terms of Reference
UN	United Nations
UNEP	United Nations Environmental Programme
UOP	Upper Ocean Panel (of CLIVAR)
WCRP	World Climate research Programme
WESTPAC	IOC Sub-Commission for the Western Pacific
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WWW	World Weather Watch (of WMO)
WWW	World Wide Web (of Interent)
XBT	Expendable BT
XCTD	Expendable Conductivity Temperature Depth instrument