Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS)

First Session
Paris, France
30 March - 1 April 1998

GOOS Report No. 56

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1. OPENING

The Chairman, Dr Tom Malone, opened the meeting at 09:30 and welcomed the participants (Annex I) to Paris, thanking them for making themselves available to work on this important activity. He explained that the Panel is responsible to the GOOS Steering Committee chaired by Dr Worth Nowlin and that the broad objective of the Panel is to develop the coastal element of a Global Ocean Observing System (GOOS), bearing in mind the activities of the related GOOS Panels on Living Marine Resources (LMR), and on the Health of the Ocean (HOTO), and the Ocean Observations Panel for Climate (OOPC). The terms of reference for the panel were reviewed. He noted that the primary objectives of the meeting are to (i) agree on goals, (ii) evaluate and build on the conclusions and recommendations of the Miami Workshop on Coastal GOOS, (iii) determine the scope of the Coastal GOOS (C-GOOS) Module, and (iv) develop an Action Plan for achieving the goals. The time table calls for the completion of the Strategic Plan in 1-year and the Implementation Plan by the end of year 2. Substantial inter-sessional work will be required to achieve this objective in the 2-3 year time frame allotted. The results of this meeting will be reported to the GOOS Steering Committee, which meets next on April 20-23, 1998.

The Director of the GOOS Project Office, Dr Colin Summerhayes, welcomed participants to UNESCO on behalf of the Executive Secretary of the Intergovernmental Oceanographic Commission (IOC), and also on behalf of the other sponsors of GOOS, namely the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP) and the International Council of Scientific Unions (ICSU). NOAA was thanked for its financial support for the meeting.

2. ADMINISTRATIVE ARRANGEMENTS

The Provisional Agenda (Annex II) was accepted with no change. Ms Muriel Cole was designated as Rapporteur. A list of background documents was provided (Annex III). Dr Summerhayes provided information on logistics and administration.

3. BACKGROUND INFORMATION

To inform the discussions, a series of talks were given on a number of topics:

3.1 THE STATUS OF GOOS

Dr Summerhayes explained the vision, mission, goals and objectives of GOOS, and reminded participants of the phases of implementation:

- phase 1: planning;
- phase 2: pilot and demonstrator projects;
- phase 3: capitalising on existing systems;
- phase 4: establishment of a fully comprehensive GOOS;
- phase 5: review and adjustment.

He emphasised that, while there is still much planning to do in GOOS, implementation has begun with establishment of pilot projects (Annex IV), demonstrator projects (GODAE - the Global Ocean Data Assimilation Experiment of the OOPC), and a GOOS Initial Observing System made up from existing systems. GOOS is about information required for operational environmental and resource management. Although it is operational, research is also required to develop GOOS fully. In addition, researchers will be among GOOS users. C-GOOS will need to identify the full spectrum of users and specify their requirements. En route to developing C-GOOS as a global initiative, we will see regional programmes develop as pilot projects, probably in regions where there is a community keen to take such projects forward. Examples of such projects are listed in Annex IV, and it is recommended that members of the C-GOOS Panel familiarize themselves with these efforts as C-GOOS will need to interact with these ongoing and developing projects.

In discussion, the need was stressed for capacity building for developing countries, and for eventual cost-benefit analyses of selected components of C-GOOS as they are identified. Among other things, ecological economics need to be assessed. These points are expanded on later in the text.

Discussion also addressed the question of what is global about coastal issues. This question was addressed in some detail in the Miami Workshop, and the rationale for C-GOOS developed in section 2 of the report of that Workshop is given in Annex V.

3.2 THE GLOBAL TERRESTRIAL OBSERVING SYSTEM (GTOS)

The Director of the Global Terrestrial Observing System (GTOS), Jeff Tschirley, explained the nature and rationale of GTOS, and the role of the global observing systems in providing information to enable Governments to meet their obligations under Conventions and other international Agreements, such as the Global Plan of Action for the Protection of the Marine Environment from Land Based Activities (briefly referred to as the GPA). GTOS is developing a coastal working group with which C-GOOS will need to interact. GOOS, GTOS and GCOS are working together through (i) GOSSP, the Global Observing Systems Space Panel, and (ii) J-DIMP, the Joint Data and Information Management Panel, to develop requirements for space-based observations, and a data and information management plan.

3.3 THE GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)

Colin Summerhayes explained the nature and rationale of the Global Climate Observing System (GCOS), one of the main drivers of which is to enable states to meet the requirements of the Framework Convention on Climate Change. GOOS and GCOS are linked through the work of the OOPC, management of which they share with the World Climate Research Programme (WCRP). The Coastal Panel will need to consider in detail the requirements for climate information and related global change in coastal seas, and provide that information to the OOPC. Changes in climate may affect coastal seas in many ways, for instance changing regional meteorological patterns and run-off, or changing ocean thermal structure and the mechanisms by which nutrients are trapped near-shore.

3.4 THE OCEAN OBSERVING PANEL FOR CLIMATE (OOPC)

George Needler outlined the way in which the OOPC and its predecessor, the Ocean Observing System Development Panel (OOSDP) have worked to identify a number of requirements and to specify the type, resolution, frequency, and accuracy of measurements needed to meet them. Most of the requirements were for information about climate change and variability on various time-scales. He also explained how the WCRP's Climate Variability (CLIVAR) project was expected to work over the next few years to measure and understand decadal change. CLIVAR will be one user of long term observations made by GOOS.

Dr Needler also requested that the C-GOOS Panel consider the kinds of data and information that will be needed from the OOPC.

3.5 CORAL REEFS

Edgardo Gomez introduced the programmes of the Global Coral Reef Monitoring Network (GCRMN), which has become associated with the International Coral Reef Initiative. The GCRMN is in the process of identifying a list of observing requirements, including socio-economic considerations. It has also identified a number of regional components, or nodes, some of which are already operational.

3.6 HARMFUL ALGAL BLOOMS (HABs)

Adriana Zingone summarized the activities of the IOC-Harmful Algal Bloom Programme, which are aimed at developing capacity in research and management of problems related to harmful marine microalgae. Under the generic terms "harmful algal blooms", a rather wide array of different problems are grouped, which are caused by different algae and affect human health and economic activities at various levels in coastal waters all around the world. HAB monitoring is carried out in several countries with the aim of minimizing damage to human health and living marine resources, as well as economic loss. The coverage is far from being adequate, especially in developing countries, along the African, south Asian and South American coasts, where the implementation of monitoring projects designed on the basis of local needs would be required. A global, long-term monitoring network in representative coastal regions would constitute a significant step forward in the attempt to understand the causes and consequences of HABs.

3.7 COASTAL INFORMATION

Tom Allen explained how satellite data are being used increasingly in ocean observations for a wide variety of users. He described the GANDER proposal for making closely spaced observations of waves from a network of 12 altimetric satellites.

In the ensuing discussion about space-based observations, Dr Summerhayes drew participants' attention to the interests of the space agencies, through (i) CEOS (Committee for Earth Observation Satellites), and (ii) the sponsors of the three global observing systems (GOOS, GCOS and GTOS), in the development of an Integrated Global Observing Strategy (IGOS), which would encourage the integration of *in situ* and space-based data. CEOS is testing the feasibility of an IGOS through 6 pilot projects, one of which is GODAE. The other oceanic pilot project is on ocean colour, for which the link is the IOCCG, the International Ocean Colour Coordinating Group of SCOR (ICSU's Scientific Committee on Ocean Research). However, in addition to getting advice on ocean colour via the IOCCG, CEOS will also get it from each GOOS Panel, because the panels are expected to identify their requirements for ocean colour data, and to feed them to CEOS through GOSSP (the Global Observing Systems Space Panel), which is jointly managed by GOOS, GCOS, and GTOS.

3.8 COASTS AND SMALL ISLANDS PROJECT

Dirk Troost introduced the UNESCO programme on Coastal Regions and Small Islands (CSI), which serves the interests, among others of Small Island Developing States (SIDS). CSI deals with the social, economic, and environmental factors in Integrated Coastal Management. CSI works through networks and Pilot Projects in the field, backed by creation of University Chairs to provide continuity and build local capacity.

3.9 LIVING MARINE RESOURCES (LMR) MODULE OF GOOS

George Grice gave participants a briefing on the meeting of the LMR Panel of GOOS, which met in Paris the previous week. The goal of the LMR module of GOOS is to provide operationally useful information on changes in the state of living marine resources and ecosystems, to describe and predict the future states of those ecosystems, and to identify more powerful methods for monitoring those ecosystems. Initially, LMR will focus on offshore conditions dominated by oceanic processes, to minimize overlap with C-GOOS.

He noted that the meeting began with reviews of the major programmes relevant to the LMR Module, including: GLOBEC; JGOFS; the Large Marine Ecosystem (LME) programme; the Continuous Plankton Recorder (CPR) programme; the Helsinki Commission (HELCOM) for monitoring the Baltic; the Oslo and Paris Commissions (OSPARCOM) for monitoring the North Sea; HAB; ICES; and PICES; and the Sloan Foundation's discussions on a proposed "Census of the Fishes".

At the LMR meeting three working groups had been formed to consider: (i) what methods/data were needed to meet users' needs?; (ii) how were these methods applicable to different ecosystems?; and (iii) how would the data be assessed and provided to modelers for conversion into useable and user-friendly products? The Panel had used the same approach as the OOPC to create a table of requirements listing monitoring methods, resolution and accuracy. In addition the Panel recognised the following gaps that would be addressed by inter-sessional activities: (i) there is a need for a compendium of significant living marine resource and ecosystem programmes worldwide; (ii) once these have been identified they must be assessed to see to what extent they supply what GOOS requires; (iii) FAO's catch statistics are currently provided in regions that are too large to be useful in relating them to environmental and ecological controls. Compilation in smaller regions is needed; (iv) FAO's catch data also need to be revised to facilitate assessments of geographically extensive straddling stocks which cross regional boundaries.

Inter-sessional assignments include: (i) development of pilot monitoring programmes. These will assess the old monitoring data from areas of significant regime shifts, to see if those shifts could have been predicted from the data; (ii) individual essays by each panel member on the panel's work and on gaps in the LMR's developing programme.

Consideration had been given to regarding the Large Marine Ecosystem (LME) programmes as LMR pilot projects. However, the LME programmes focussed on Exclusive Economic Zones, so miss the ocean component of these continental margin ecosystems.

3.10 HEALTH OF THE OCEANS (HOTO) MODULE OF GOOS

Neil Andersen reviewed development of the plans for the HOTO Module of GOOS, which had led to a strategy for focussing first on making technically straight forward measurements that have a high impact (such as nutrients). The HOTO Plan provides a prioritorized, generic framework for the development of pilot projects, several of which have recently been proposed. The plan also identifies where research is needed as the basis (i) for developing or refining the necessary observing technology for a GOOS, and (ii) for developing appropriate models with which to process the data and produce products. The main driver for the HOTO Plan is the requirement by Governments for global and regional assessments of the state of the health of the

environment. Capacity building and sustainable development must be an important part of the eventual implementation.

The close connection between the HOTO Module and the IOC/UNEP/IMO Global Investigations of Pollution in the Marine Environment (GIPME) was also detailed. It was emphasized that the IOC Assembly has designated GIPME as the IOC programme within which HOTO pilot projects are to be implemented in full consultation with the GOOS Project Office, the GOOS Steering Committee, and relevant GOOS panels (Resolution XIX-4).

3.11 U.S. COASTAL GOOS

Neil Andersen also reviewed plans for the development of a US Coastal GOOS programme. US C-GOOS has three major operational categories reflecting different user groups: (a) sustainable healthy coasts (building on the needs of the HOTO Module), (b) natural hazards, and (c) safe navigation. In developing the goals for the sustainable healthy coasts element, it was decided to divide coastal systems into 5 categories:

(i) urban estuary;
(ii) barrier island;
(iii) rocky shore;
(iv) inland sea/lake; and
(v) river-dominated.

The GTOS connection will be essential, especially for inland sea/lake and river-dominated systems where land run-off is likely to be a significant contributor, for instance, in urban estuaries. To take this work forward, an important next step will be to identify the sensor technology needed to underpin the programme; to this end, a session on *in situ* sensor technology is being organized by Andersen and Malone for the next Marine Technology Society (MTS) conference in Baltimore (16-19, November, 1998).

3.12 LAND-OCEAN INTERACTION IN THE COASTAL ZONE (LOICZ)

Julie Hall reviewed the LOICZ programme, reminding participants that this major programme aims to improve understanding of much of the science of coastal seas and their interactions with the land and the open ocean. Participants were provided with the LOICZ Science and Implementation Plans and the LOICZ Typology.

3.13 COASTAL MEETING (Miami)

Eduardo Marone reminded participants of the recommendations of the meeting of the *ad hoc* Working Group on the GOOS Coastal Module, which took place in Miami on February 24-28, 1997, and which the present Panel is expected to follow up (Annex V). The report of the meeting was among the background papers provided to participants.

4. DISCUSSION ON THE GOALS OF C-GOOS

Prior to the meeting of the panel, the chairman circulated a “think piece” on the goals of the C-GOOS panel (Annex VI) to promote pre-meeting discussion and facilitate the development of a consensus among panel members. With this as a point of departure, the chairman led an extended discussion designed to solicit participants’ views on the goals and scope of Coastal GOOS. This discussion set the stage for the development of the panel’s action plan. The following key points were made:

(i) First identify the issues and problems, then ascertain the data and information needed to address them.

(ii) Assuming that one of the primary goals is to nowcast and forecast environmental change over a range of scales, the full range of modeling approaches and observational capabilities will be required. In order to determine the kinds of models and observing systems that will be needed, it is necessary to define exactly what is to be predicted and what is to be measured. This will lead to the selection of modeling approaches and specification of the resultant products. A critical aspect of such an approach is the observing system that fuels the model (s). It must be able to detect and quantify episodic inputs of energy and matter and responses to such inputs.

In this regard, it was recognized that the scarcity of observations on coastal environments that are of sufficient duration, spatial extent, and resolution and the lack of knowledge (theoretical and empirical) on the propagation of variability across scales through and among coastal

ecosystems are major barriers to the goals of nowcasting, forecasting and predicting environmental changes and their consequences.

Many of the models we might wish to use are not complex. The degree of complexity required must be borne in mind in the design of C-GOOS. In some cases models may run on supercomputers; in other cases they may be rules of thumb. Nested models with differing degrees of resolution are likely to be needed given the complex local nature of the coast on the one hand, and the relative homogeneity of the adjacent coastal sea on the other hand. Larger scale phenomena, like currents, sea-level, and storm surge lend themselves to more advanced modelling. Some coastal events are driven by events thousands of miles away, which affect forcing at the offshore boundary of the coastal sea. Predicting plankton patchiness, on the other hand might be as difficult as precisely predicting local weather.

(iii) For the benefit of developing nations the task of C-GOOS should be to provide road-maps or blueprints addressing realisable goals, such as storm surge forecasts or the modelling of probable transport paths of harmful algal blooms, oil spills, etc. To be do-able, useful, and continuous, especially worldwide, C-GOOS should focus on a small number of inexpensive measures made globally. Is there such a common set of multi-purpose variables the measurement of which will yield data required to address relevant problems? If so what are they?

(iv) Pilot projects are required to demonstrate that the GOOS concept will work in the coastal zone and that it fills a unique and important niche. In addition to demonstrating that networking mechanisms can be put in place that make possible the timely exchange of data and information on appropriate scales, pilot projects should focus on geographic areas of interest to coastal managers and on key problems in terms of important operational issues. Pilot projects are required in both the developing and developed world, but are likely to be different in each case. Users will be convinced by results, so some pilot projects must be designed to obtain quick results. However, users should not be led to understand that GOOS is about quick fixes - it is a development for the long term, in which time series information is a valuable product. In choosing themes for pilot projects it would be wise to apply (replicate) technologies that are known to work, so as to minimize the risk of failure, in order to get the concept to spread quickly.

(v) Making best use of existing systems is a key element of C-GOOS. In this context, programmes like Mussel Watch, GLOSS, GCRMN, HAB could be networked to create an Initial Observing System for C-GOOS, enabling information synthesis for coastal management. Consideration needs to be given urgently to integrating existing IOC programmes with GOOS in such a way that the original customers for those programmes are not disadvantaged. C-GOOS could also become a framework for existing national monitoring systems, which can contribute to it provided they meet basic GOOS requirements.

(vi) The design must be flexible to accommodate changing technology.

(vii) Education of the user community should include demonstrations that illustrate the benefits of C-GOOS - that C-GOOS provides an effective means of solving relevant problems. Users need convincing that others share similar problems, and that each can gain from the others by being involved collectively. The user community (including policy makers) should be involved in the design from the beginning. Education must start now before the fully fledged GOOS is available. Educating policy makers will require consideration of the fora in which that education should take place to be most effective.

(viii) In designing C-GOOS and in educating the user community, it must be borne in mind that the managers of coastal systems are usually not themselves well-coordinated within anyone country or region. Not only do the missions and goals of many government agencies overlap in the coastal zone, the management process is highly fragmented regionally. C-GOOS will need to convince these disparate users that the integrated framework approach of C-GOOS brings benefits.

(ix) Cost-benefit analyses may provide a useful tool in persuading governments to invest in C-GOOS. In considering the issues and problems, economic concerns must be borne in mind, such as (a) the cost of pollution caused by fish farming, (b) the economic effects of contamination of coastal waters by agricultural practices (nutrient runoff), (c) the economic consequences of changes in ecosystems caused by changes in fishing practices, (d) lost revenues from tourism and aquaculture, resulting from pollution. Economics must be considered as one of the forcing factors.

(x) One benefit not to be lost sight of is the continuity the C-GOOS approach could (should) bring to data collection efforts across changes in government. Experience shows that only 1:20 monitoring

programmes survives more than 1 decade; only 1:80 survives more than 2 decades. C-GOOS must do better.

(xi) C-GOOS will have to find a means to address the trend towards commercialisation of data, which tends to act against the data sharing essential to integrated coastal zone management.

(xii) A survey is needed like that proposed by the LMR Panel of who is doing what, when, where and how.

5. DEVELOPING THE ACTION PLAN

The Action Plan is intended to guide the panel as it works to formulate Strategic and Implementation Plans for the Coastal Module of GOOS. The development process revolved around a discussion of the issues that must be addressed in these plans and of the information that must be gathered to provide the foundations upon which they will be developed.

5.1 THE SCOPE OF C-GOOS

5.1.1 Goals of the GOOS Coastal Panel

The charge to the C-GOOS Panel is to prepare strategic and implementation plans that functionally link measurement programmes (observation systems) to the production of products that are beneficial to society and to various user groups, i.e. an end-to-end system that is responsive to user group needs. The goals of the panel are to

(i) determine user needs in the coastal zone and specify the environmental data and products required to satisfy these needs;

(ii) identify regions where current monitoring efforts are inadequate and formulate plans to fill these gaps;

(iii) identify inadequacies in the measurement programs of current observation systems in terms of the variables measured, the scales on which they are measured, and their usefulness;

(iv) promote regional to global coordination and integration of monitoring, research and modelling;

(v) promote the design and implementation of internationally coordinated strategies for data acquisition, integration, synthesis and dissemination of products; and

(vi) promote the use of regional to global networks to improve now-casting, forecasting and prediction of environmental change in the coastal zone.

As the panel works to formulate strategic and implementation plans for achieving these goals, it will coordinate with OOPC, HOTO and LMR panels to incorporate coastal observations required for the delivery of products to their user groups; with national and regional GOOS activities (e.g. EuroGOOS, NEARGOOS, US Coastal GOOS); and with other relevant programmes (e.g. GTOS, LOICZ, CARICOMP, DIVERSITAS, Coastal LTER networks).

As a point of departure, the panel considered the recommendations of the Miami C-GOOS workshop (February, 1997) which are to form a C-GOOS Panel that will (a) insure analyses of the full range of environmental issues and problems in the coastal zone; (b) define sets of core variables; (c) assess the requirements of other GOOS modules in the coastal zone and integrate them with the C-GOOS module; (d) encourage R&D to meet GOOS goals; and (e) encourage regional GOOS efforts to conduct cost-benefit analyses to determine services of greatest value, promote market research on needs for C-GOOS products, establish stronger links with industry, develop programmes that involve developing countries and promote capacity building, and develop coastal environmental data services.

5.1.2 Geographic boundaries

In the broadest sense, the limits of C-GOOS are considered to be the landward limit of marine influences and the seaward limit of land influences. More explicit boundaries should be defined based on the problem or issue to be addressed.

5.1.3 Operational categories and ubiquitous issues

The panel considered the viability of the US Coastal GOOS definition of operational categories: (i) Sustain Healthy Coasts; (ii) Mitigate Natural Hazards, and (iii) Safe Navigation. After some discussion, a working group was charged with developing operational categories as a means of organizing ubiquitous issues into functional groups. The groups recommended and the panel accepted the following modified version of the operational catagories adopted by US Coastal GOOS: (i) preserve healthy coastal environments, (ii) promote sustainable use of coastal resources, (iii) mitigate coastal hazards, and (iv) ensure safe and efficient marine operations. These were used to organize globally ubiquitous issues (Table 1).

Table 1. Globally ubiquitous issues organized according to operational categories for coastal products and services.

OPERATIONAL CATEGORY	ISSUE
Preserve Healthy Coastal Environments	habitat loss and modification (e.g., wetlands, SAV, coral reefs)
	nutrient over enrichment (e.g. eutrophication, hypoxia/anoxia)
	toxic contamination, oil spills
	diseases in marine organisms
	harmful algal blooms
	non indigenous species
	biodiversity
Promote Sustainable Use of Coastal Resources	exploitation of living resources
	mariculture (pond and open water)
	saltwater intrusion
Mitigate Coastal Hazards	flooding, storm surges, tsunamis
	wind: tropical storms
	harmful algal blooms
	erosion
	sea-level rise
Safe and Efficient Marine Operations	safe navigation
	efficient maritime commerce
	exploitation of nonliving resources
	spills of hazardous materials (oil, chemicals, radioisotopes)
	ballast water (e.g., transport and release of non indigenous species)

5.1.4 Capacity Building

Building the capacity of developing nations to contribute to and participate in GOOS is a key feature of the GOOS Strategic Plan. This was addressed at the Miami Workshop (Annex V) and is a high priority of the C-GOOS Panel.

Bill Erb explained the operations of the GOOS Capacity Building team, which has completed 4 awareness building workshops in India, Mombasa, Malta and Fiji, to address the needs of these regions. Each region has identified Coastal GOOS as its top priority. As part of this exercise the participating nations use a questionnaire to identify their present capabilities and technologies and future needs. This has been a first step in setting up regional GOOS programmes such as WIOMAP in the western Indian Ocean; Pacific-GOOS; and MED-GOOS. Capacity is also built through IOC training programmes, such as those organized annually by NEARGOOS, GLOSS, and HAB. IOC training comes under the Training, Education and Mutual Awareness (TEMA) programme, which needs to be effectively integrated with GOOS activities. Capacity building will be an important part of the C-GOOS Implementation Plan, the formulation of which should consider and build on these efforts.

5.2 COASTAL TYPOLOGY

With the notable exception of remote sensing, it is obvious that the resources do not exist and will not exist to monitor all coastal systems even if such an effort could be justified. Thus, coupled monitoring-research programmes must be designed and implemented that will allow interpolation among systems and extrapolation to systems or conditions beyond the range of observation. This requires the definition of functional groups of coastal systems early in the design phase of C-GOOS. In considering a possible coastal typology, it was recognised that LOICZ is using a statistical approach (cluster analysis) to develop a classification scheme for coastal systems. Although C-GOOS could adopt the same scheme, it is not clear that it would be appropriate to the goals of GOOS. US Coastal GOOS adopted a different and more subjective approach (section 3.11).

Among other things, functional categories of coastal ecosystems would have to be considered on a watershed scale. In developing a classification scheme for C-GOOS, the following aspects of the problem should be considered:

(i) patterns of external forcings (meteorology, terrestrial inputs, exchange with the ocean);

(ii) habitat characteristics (circulation regime, size, shape, depth, benthic substrate, nature of the margins); and

(iii) scaling relationships for comparative analyses (e.g. drainage basin area relative to area and volume of the receiving body of water; anthropogenic nutrient load as a proportion of total load; surface area to volume; freshwater fill time; tidal relative to nontidal flows; benthic production relative to pelagic production).

After some discussion, the decision was made to form a working group to address this problem during intersession.

5.3 DEVELOPMENT OF PILOT PROJECTS

Pilot projects are needed to demonstrate that data and information can be used on larger scales to address problems that are locally relevant and to demonstrate the cost-effectiveness of the C-GOOS strategic and implementation plans. Pilot Projects must not only be tractable (high probability of success), they must demonstrate the utility and value added nature of the GOOS approach.

It was recognized by the panel that there is a need to link bottom-up (priorities of the research community) and top-down (user needs) perspectives (the end-to-end, user driven approach of GOOS). Critical links between these “end members” include precise definitions of those features of environmental change that should be assessed and visualized in real time (e.g. water depth, wave fields, spatial weather patterns); of those attributes that should be predicted; and of acceptable time lags between observation and the production of products (e.g. from now-casting to weather forecasts on daily to interannual scales to predictions of climate change).

Potential users have been identified and consulted through a variety of efforts including (i) the capacity building workshops of the GOOS Capacity Building Panel, (ii) the work of the GOOS Coastal Working Group in Miami, (iii) the US Coastal GOOS Workshop, and (iv) NEARGOOS and EuroGOOS customer surveys. User groups include policy and decision makers in government; government agencies responsible for regulating and managing coastal zone development, the environment, natural resources; private industry; non-governmental organizations; and the scientific community. The panel also emphasized the importance of public education and the public service role that C-GOOS should play in promoting the use of monitoring data to better inform the public of the causes and consequences of environmental changes that are occurring in the coastal zone. To achieve the goal of an end-to-end, user driven mode of operation, C-GOOS should (i) develop mechanisms for consulting users about their needs and for exploring potential applications of data generated by coastal observing systems, e.g. through workshops, web site discussion groups, regional or national GOOS programmes; and (ii) encourage regional and local GOOS groups to consult user groups about their interests in particular products.

In addition, it was agreed that C-GOOS should organize panel meetings in different regions as a means of promoting linkages with user groups at the grass root level. On these occasions, C-GOOS should organize workshops to (i) convey the C-GOOS message; (ii) solicit user input; and (iii) to identify and address regional needs for capacity building.

The Miami Workshop (Tables 1-5 in the workshop report) provides a useful starting point for the early design phase of pilot projects that demonstrate the feasibility and utility of C-GOOS (Annex V). Additional elements include definition of (i) end products based on model outputs; (ii) the time-scales on which forecasts or predictions are required; (iii) the kinds of models that might be needed to make predictions and forecasts; (iv) inputs to and outputs from such models; and (v) the potential costs and benefits of the data collection-modelling enterprise. The cost-benefit analysis should include assessments of the feasibility (availability of technology and cost) of making the required predictions and measurements in terms of their probable political, social and economic impact.

A working group was charged with the task of developing a more comprehensive, systematic approach to linking issues to user needs using results from the Miami Workshop as a starting point. The following categories were identified for inclusion in a tabular analysis (Table 2): operational category and issue (from Table 1), users, attribute to be predicted, lead time (between input and prediction), model type, inputs to model (variables), outputs from model (trend, map, etc.), and results of cost/benefit analysis (impact/cost). A second table (Table 3) is also needed that lists each variable to be measured, the required scales of measurement, importance of the variable, the feasibility of measurement, and the availability of proven techniques and technologies.

Table 2. Pilot Project Design Table: select operational category (Op Cat) and issue from Table 1; identify and consult user groups; describe attributes to be predicted; determine acceptable lag time between input and product availability; determine the type of model to be used (“model” in its broadest sense, e.g. from simple arithmetic and statistical models to 3-d, time-dependent numerical models); define input variables and determine output form; results of cost-benefit analysis (including feasibility of approach and impact of solving the problem).

Op Cat	Issue	Users	Prediction	Lead Time	Model Type	Model Inputs	Model Output	Cost - Benefit

Table 3. Analysis of Input Variables: variable to be measured (model inputs), scales of measurement (required resolution in time and space of measurements, a real coverage and temporal duration of measurements), a ranking of each variable in terms of its importance to the modelling effort (impact), the feasibility of measuring each variable, and availability of proven techniques and technologies.

Variable	Scales	Rank	Feasibility	Technology

This process of linking measurements to products via user needs and of evaluating cost-benefits (feasibility vs impact) will be used to identify and design priority pilot projects for C-GOOS.

In linking measurement to products, C-GOOS should promote the development of sensor technology for the measurement of a wider range of variables as a means of expanding the range of products and services available for users. Particular attention should to be paid to *in situ* and remote sensing. In regard to *in situ* sensing, resolving patterns of change (trends) from variability (noise) will require high resolution time series of extended duration to capture the spectrum of variability characteristic of coastal systems. The design and implementation of observation programmes should incorporate high frequency *in situ* measurements and real time telemetry of data that can be rapidly disseminated, assimilated and visualized for the purposes of now-casting and forecasting environmental variability and change. Technologies are evolving quickly (e.g. new satellite sensors, new *in situ* sensors, data transmission, faster computers) and the potential for significant increases in measuring and modelling capabilities over the next 5-10 years is high. The panel needs to promote the development of inexpensive technologies and to facilitate their transfer and use by developing countries.

The effectiveness of C-GOOS also depends on high density measurements of appropriate variables (e.g. phytoplankton pigments, temperature, salinity, waves). C-GOOS should promote the use of SeaWiFS and other spaceborne sensors and should support continued efforts to sustain and improve remote sensing programmes that provide data relevant to environmental change in the coastal zone. For example, there is an immediate need for more satellite receivers in coastal areas of developing countries and for expanded development of colour applications. Given the importance of land-sea interactions in the coastal zone, C-GOOS should assess requirements for remote sensing in the coastal zone (terrestrial and marine environments) in terms of existing and planned satellite capabilities. A recommendation on these issues is needed for GOOS to take to the CEOS Plenary in November 1998.

Finally, and perhaps most important, the strategic and implementation plans formulated for C-GOOS should promote continued interaction among research, monitoring and modelling efforts and the application of results for the purposes of public education as well as for specific user groups.

In summary, some Pilot Projects should be devised to address a minimum number of parameters on a global scale. They should address solvable problems, and demonstrate the value of data sharing. They should have a finite lifetime, which could be as short as 2-3 years, depending on requirement. In the GODAE pilot project there will be a series of phases starting in 1998 and leading up to the full scale experiment in 2003-2005. Other Pilot Projects should be driven by user needs on regional scales. Annex IV gives examples of ongoing or possible regional C-GOOS pilot projects. Also listed in Annex IV are the HOTO priority areas for coastal seas (from the HOTO Strategic Plan). More recently, the HOTO Panel has outlined pilot projects in the Red Sea, the Black Sea, the Arctic, N.E. Asia (which would be part of UNEP's Regional Seas programme, NOWPAP), and S.E.Asia. In considering the establishment of Pilot Projects careful attention should be given to what C-GOOS expects to get out of them in the way of products, and to using the projects and their products to attract and create a user community. Attention should also be given to converting C-GOOS project outputs into educational materials. Potential pilot projects discussed by the panel are listed in section 6.

5.4 GLOBAL INVENTORY OF COASTAL MONITORING PROGRAMMES

If C-GOOS is to be effective in its role of networking coastal monitoring programmes on regional to global scales and of identifying local-regional gaps in coastal measurements and capabilities, a global inventory of monitoring programmes (metadata) will be needed. A similar need has been identified by the LMR Panel. There is a clear need for a comprehensive directory of programmes and associated metadata.

As a start, information on current monitoring operations may be found in the GOOS National Reports submitted by participants in I-GOOS meetings. Panel members, national GOOS contacts, and IOC national contacts can all assist in developing the list of local observing systems and can act as local agents to spread information about GOOS. The UNEP network of regional seas programmes may also be exploited for this purpose. In due course, C-GOOS will need to evaluate this information to establish (i) the extent to which they can contribute to the goals and objectives of C-GOOS, (ii) gaps in the use of existing technologies; and (iii) gaps in geographic coverage.

5.5 COORDINATION

The number of programmes that are relevant to the work of the C-GOOS Panel is large and growing. If C-GOOS is to keep from "reinventing the wheel" and duplicating the efforts of other groups, the panel must work to become familiar with these programmes. In this regard, the Panel asks that the IOC not only provide it with relevant reports, but that it also informs relevant programmes of the activities of the C-GOOS Panel and works to coordinate activities as needed.

5.5.1 Relations to LMR, HOTO and OOPC Modules of GOOS

The goal of the LMR Module of GOOS is to "provide operationally useful information on changes in the state of living marine resources and ecosystems" with an emphasis on "offshore conditions dominated by oceanic processes." The goal of the HOTO Module is to "provide a basis for the assessment of the state and trends in the marine environment regarding the effects of anthropogenic activities including, *inter alia*, increased risks to human health, harm to marine resources, alterations of natural change and general ocean health." Given that most living marine resources are in the coastal zone, where human impacts are most pronounced, the strategic and implementation plans for C-GOOS must integrate and synthesize the needs of the LMR and HOTO panels into comprehensive, holostic plans to address the operational priorities of C-GOOS (Table 1). The contributions of C-GOOS to this process include developing plans for

(i) implementing coordinated, integrated programmes of monitoring, research and modelling that provide meaningful indicators of ecosystem health and useful predictions of environmental change;

(ii) evaluating the efficacy of actions taken to manage environmental impacts and the exploitation of living resources; and

(iii) responding to the information needs of decision makers, government agencies, industries, and the public as related to the preservation of healthy coastal environments, the sustainability of coastal resources, the mitigation of coastal hazards, and safe and efficient marine operations.

Recognizing that most environmental perturbations affecting the health of the ocean are manifested in the coastal zone, the strategic plans of the HOTO and the Coastal Modules will be implemented as one. The development and implementation of the Healthy Coasts and Sustainable Resources elements of the C-GOOS Strategic Plan will use the good offices of the GIPME Programme to coordinate with and build on existing (e.g. MARPOLMON) and planned (e.g. NOWPAP, CAOS) monitoring networks.

The goals of the Ocean Observations Panel for Climate (OOPC) are to monitor, describe and understand the physical and biogeochemical processes that determine ocean circulation and its influence on the carbon cycle and to assess the effects of the ocean on seasonal to multi-decadal climate changes. The OOPC has identified data assimilation to make the best use of satellite observations as the immediate, major challenge and is addressing this through the Global Ocean Data Assimilation Experiment (GODAE, a Pilot Project of OOPC). The chair of this panel has asked the C-GOOS Panel to advise the OOPC Panel on the information needs and products from OOPC required to achieve the goals of the C-GOOS module.

To ensure effective linkages to the other GOOS Panels, the Panel recommends that the Chairman of C-GOOS, or his representative, be invited to participate as an observer in meetings of the HOTO, LMR and OOPC Panels.

5.5.2 GTOS, GLOSS, Regional GOOS efforts, and other related operational programmes

The Global Sea Level Observing System (GLOSS) is an example of a global network that is producing coastal data and products that must be integrated into the strategic and implementation plans for C-GOOS (contact: Dr Philip Woodworth). Likewise, observation systems that document local to regional weather patterns and changes in land-cover and land-use in drainage basins of coastal aquatic environments must be integrated into C-GOOS, an effort that will require coordination with the Coastal Zone Working Group of the Global Terrestrial Observing System (GTOS); (contacts: Dr Vineeta Hoon, Dr Jim Gosz).

C-GOOS should capitalize on and declare a vested interest in presently existing or planned coastal seas regional projects (e.g. NEARGOOS, EuroGOOS, MEDGOOS, PacificGOOS). As recommended by the Miami C-GOOS Workshop participants, the C-GOOS panel should work with regional GOOS programmes to encourage the use of cost-benefit analyses to determine services of greatest value, to promote market research on needs for C-GOOS products, to establish stronger links with industry, to develop programmes that involve developing countries and to promote capacity building, and develop coastal environmental data services.

The Caribbean Coastal Marine Productivity (CARICOMP) network of marine laboratories provides a model for the kinds of regional efforts that C-GOOS should promote and help to link into a global network (contact: Dr John Ogden). CARICOMP was established in 1985 and currently has about 25 cooperating sites in over 16 Caribbean and Latin American countries. CARICOMP is funded by the sites themselves and by UNCESCO/CSI, the MacArthur Foundation, and the ICRI (through NSF). Since 1992 the network has conducted a standardized, synoptic set of measurements of coastal ecosystems (coral reefs, seagrasses and mangroves) structure and function and of meteorological and oceanographic variables. Data are archived and distributed by the University of West Indies (Kingston, Jamaica). The network also provides the infrastructure to respond to phenomena such as coral reef bleaching and disease events.

5.5.3 LOICZ

C-GOOS should promote functional interactions between research and monitoring programmes (monitoring to quantify variability and detect change; research to determine the underlying causes and consequences of change). The IGBP programme to study Land-Ocean Interactions in the Coastal Zone (LOICZ) is an example of such a research programme. The goals of LOICZ are to

(i) determine on global to regional scales (a) the fluxes of material among terrestrial, marine, and atmospheric systems through the coastal zone, (b) the capacity of coastal systems to transform and store particulate and dissolved matter, and (c) the effects of changes in external forcings on the structure and function of coastal ecosystems;

(ii) determine how changes in land-use, climate, sea-level and human activities alter coastal morphodynamics and the fluxes and storage of particulate matter in the coastal zone;

(iii) determine how changes in the coastal zone affect the global carbon cycle and trace gas composition of the atmosphere; and

(iv) assess how such changes influence human activities in the coastal zone and provide the information needed for integrated management of the coastal environment.

Clearly, the C-GOOS Panel must coordinate its activities, including the development of pilot projects, with research programmes conducted under the auspices of LOICZ and other research activities that are directly related to the design and implementation of coastal observing systems [e.g. GLOBEC, CoOP, Coastal Index Sites, and Long-Term Ecosystem Research (LTER) programmes in the coastal zone]. The C-GOOS Panel will need an inventory of such programmes with documentation and contact persons so that it can begin the task of determining how best to utilize the research results and discoveries for the purposes of GOOS and to promote research in the coastal zone through the dissemination of data and products. This effort can benefit from the development of research and monitoring networks by other agencies, such as the Commission of Maritime Regions in Europe (Action: Elisabeth Lipiatou to send the information to the GPO).

5.6 COMMUNICATION

C-GOOS will be represented at the TOS meeting on coastal oceanography in Paris (June 4-7, 1998) and at the MTS meeting in Baltimore (November 1998). C-GOOS will coordinate its activities with EuroGOOS by sending a representative to the EuroGOOS conference planned for spring 1999. In due course, the C-GOOS Panel will organize a workshop to advertise the C-GOOS programme, to attract involvement, and to explore user needs. The conference on Environmental Management of Enclosed Coastal Seas (EMECS) to be held in Turkey during the fall of 1999 may provide a venue for this purpose.

The Panel recommends that a C-GOOS brochure be produced following the completion of the strategic plan. This would be used by Panel members and other to advertise C-GOOS regionally. In the interim, a GOOS brochure is being developed to describe the international GOOS programme. C-GOOS will be invited to contribute to its design and content. For meetings, it may be worthwhile developing a C-GOOS poster; there is a GOOS poster available, but it is large and cumbersome, and not easily transportable.

The Panel will rely on e-mail for most communications. It was requested that the IOC put up a web site (password access) to facilitate communications among Panel members and the completion of intersession tasks by working groups.

6. INTERSESSION ACTION PLAN

This section outlines the action plan developed for intersessional work in preparation for the next panel meeting to be held in Brazil during early November, 1998. Reports from the working groups are to be completed by 1 September.

Action 1: Tom Malone (chair) & Colin Summerhayes

Review goals, plans and recommendations of HOTO, LMR, and Capacity Building Panels and of the US Coastal GOOS Workshop on Sustainable Healthy Coasts. Identify components that are relevant to C-GOOS in terms of (a) the scope of problems and issues to be addressed by C-GOOS (e.g. geographic boundaries, operational categories, socio-economic problems, education); (b) the definition of functional categories of coastal systems; (c) the spectrum of environmental problems and changes to be addressed by C-GOOS; (d) and users, products and services (including public education).

Action 2: Tom Malone (chair), Osvaldo Ulloa and George Needler

Review goals, plans and recommendations of the OOPC panel and determine the data and information needs of C-GOOS in terms of the effects of weather, climate change, and oceanic forces on the coastal zone.

Action 3: Larry Awosika, Carlos Duarte and Jozef Pacyna (chair)

Review goals, activities and recommendations of the LOICZ Programme, GTOS and other related programmes. Identify components that are relevant to C-GOOS in terms of (a) the scope of C-GOOS (e.g. seaward and landward boundaries, interactions between research and monitoring activities, products and users); (b) the definition of functional categories of coastal systems; and (c) the spectrum of environmental problems and changes to be addressed by C-GOOS.

In regard to functional categories, evaluate those defined by the LOICZ method in terms of their habitat characteristics (e.g. size, shape, bathymetry, benthic substrate, nature of the margins, circulation regime) and scale relationships that may be used in a comparative analysis of systems (e.g. drainage basin area/area, volume of receiving water; anthropogenic nutrient load/total load; surface area/volume; freshwater fill time, tidal flow/non-tidal flow, benthic/pelagic production & biomass).

Action 4: Elisabeth Lipiatou, Yoshihisa Shirayama and Colin Summerhayes (chair)

Review goals, plans and recommendations of regional GOOS Programmes (EuroGOOS, NEARGOOS) and develop recommendations for how C-GOOS can support their efforts and for activities that should be implemented on the regional scale.

Action 5: Bud Ehler, Julie Hall, Jozef Pacyna, Keith Thompson (chair), and Stephen Walker

Using the operational categories for C-GOOS and the scheme for organizing “ubiquitous” environmental issues (Table 1), complete the Pilot Project Design Tables for all issues (Tables 2 and 3).

[NOTE: This effort should be coordinated with the development of pilot projects.]

Action 6: Neil Andersen and Julie Hall (chair)

Identify and develop a rationale for key variables and indices that are most sensitive to external forcings and/or portend of significant change to come (organized by operational catagory). Evaluate variables to be measured in terms of the difficulty (cost) of measurement versus the impact (value) of the measurement. Is there a core set of variables that should be measured for all cases or for operational categories (multipurpose measurements}?

Action 7: Pilot Projects (details to be completed prior to C-GOOS-II, Nov., 1998)

Using the Pilot Project Design Tables 2 and 3 as a starting point, describe in detail potential pilot projects that could be used as "proof of concept."

(i) Eastern South Pacific [Janet Campbell, Keith Thompson & Osvaldo Ulloa (chair)]

A pilot project dealing with the control on coastal circulation by the wider circulation of the S.E. Pacific. This recognises that coastal currents are controlled by what happens several thousand miles away along the equator. Knowing how the signals are transmitted, and given adequate observations, 2-months warning of currents off Chile can be derived from observations at the equator and between it and Chile. Data gathering would involve TAO, GLOSS, coastal data buoys, networking between countries, and satellite data. Stakeholders and data gaps need to be identified; workshops will be used to establish user needs. The time frame can be as long as required (e.g. spanning an El Niño). Products could include predicted currents, local El Niño effects, fishing potential.

(ii) Remote sensing and Validation in coastal waters [Sinjae Yoo (chair) & Janet Campbell]

At the global scale, recognising that the four things a satellite can measure are (a) ocean colour; (b) SST; (c) surface winds (from surface roughness), and (d) sea-level (by altimetry), C-GOOS could well recommend a project to collect local and regional *in situ* measurements from within EEZs as the basis for calibrating satellite measurements. This project would probably also be acceptable as a Pilot Project by CEOS.

(iii) Harmful Algal Blooms [Neil Andersen, Eduardo Gomez, George Grice, Julie Hall, Jozef Pacyna & Adriana Zingone (chair)]

A harmful algal bloom monitoring and prediction project in the developing world (e.g. Manila Bay). Such a project might well qualify for GEF funding.

(iv) Western Pacific Biodiversity [Yoshihisa Shirayama]

(v) Disaster Mitigation, Storm Surges [BR Subramanian, Keith Thompson & Stephen Walker (chair)]

A number of nations are in the process of developing and implementing semi-operational storm surge models to provide assessments of likely coastal impacts, and to warn affected populations. These could relatively easily be replicated for developing countries. This pilot project would promote:

- larger scale, regional skill in storm surge prediction;
- development of common methods and approaches to storm surge modelling;
- better linkages to atmospheric (meteorological) programmes in order to obtain more accurate estimates of storm tracks and intensity.

Initially the project would focus on regional efforts in the Bay of Bengal, related to the flooding of Bangladesh and surrounding areas.

(vi) Networking Metadata [Stephen Walker].

(vii) Northern Adriatic [Tom Malone].

(viii) In addition, the Panel agreed that it would be useful to develop a baseline coastal data atlas, like the NOAA/NASA global ocean atlas (based on data archaeology). Effective exchange of and access to data are essential parts of C-GOOS. This pilot project would promote the development of linkages between existing coastal databases. It would demonstrate a widely accessible interface to a range of existing and planned coastal monitoring programmes and other activities in the coastal zone. This could form a contribution to the development of an Information Centre for the three Global Observing Systems (G3OS), currently underway in the USA.

Action 8: Bud Ehler (chair), Julie Hall and Eduardo Marone

Develop recommendations for activities that will promote functional linkages among scientific and user groups (including the scientific community itself, e.g. data interpretation/synthesis and consensus building within scientific community) and will involve all stakeholders in the planning process from the beginning.

Action 9: Colin Summerhayes

Assess the availability and quality of data on environmental conditions and change in the coastal zone. [NOTE: The panel requests the IOC to compile a global inventory of coastal monitoring programme and associated metadata in time for the next panel meeting.]

Action 10: Larry Awosika, Bill Erb, Eduardo Marone (chair) and Br Subramanian

Review goals, plans and recommendations of the IOC Capacity Building Panel. Identify components that are relevant to C-GOOS and develop recommendations for the capacity building component of C-GOOS.

7. MEMBERSHIP AND COMPOSITION

The Panel expressed concern that most of its members are scientists, i.e. other stakeholders, including representatives from government regulatory and management agencies, industry, public policy groups, NGOs, are either not represented or are poorly represented. Given that the size of the committee is finite, panel members were asked by the Director of the GOOS Project Office to suggest the names of individuals who should be invited to attend meetings on an *ad hoc* basis, as a means of involving potential user groups in the work of the Panel.

8. TERMS OF REFERENCE

The Panel considered the Terms of Reference and associated Objectives (Annex VII) and agreed that they are acceptable.

9. RESOURCES REQUIRED

The Panel recommends that it meet next in Brazil during November, 1998. It was strongly felt that the completion of the Panel's work will require meetings at about 6-month intervals. Long intervals between meetings (e.g. 12 months) will result in a loss of momentum and enthusiasm. The Panel also endorsed a proposal to hold its meetings in regions that provide an opportunity for involving stakeholders and for capacity building as part of their meetings. Given the demand for implementation of C-GOOS from countries around the world and the need for planning in this area to catch up with that in the Climate and HOTO areas so as to increase the credibility and support base of GOOS, Panel members strongly urged the Director of the GOOS Project Office to make this a high priority for funding. The GPO will work to develop the needed funding. The C-GOOS work programme and budget will first go to the GSC meeting (April 20-23) for approval before the time of the next meeting is finalized.

In arranging meetings it would help to consider tying C-GOOS meetings to other meetings to keep travel costs as low as possible. The possibility was also mentioned of making one of the C-GOOS meetings a NATO conference, which would facilitate the funding of participants travel and subsistence.

10. OTHER BUSINESS

There was no other business.

11. DATE AND VENUE OF NEXT MEETING

Eduardo Marone offered to host the next meeting at the Centro de Estudos do Mar da UFPR with the assistance of the GPO, especially Ms Janice Trotte, who is seconded to the GPO from Brazil. Brazil will make a formal offer. Although the precise venue and date remain to be determined, the meeting will probably take place in Curitiba, Brazil, during the first week of November, 1998. Preliminary discussions with the University indicate strong support and a venue that satisfies criteria established earlier by the Panel in terms of capacity building and the involvement of stakeholders.

Assuming that meetings are held at 6-monthly intervals, the 3rd meeting of the Panel will be in March/April 1999. Larry Awosika suggested that it should be held in Africa. C-GOOS is very important to Africa because of the socio-economic importance of coastal areas. Many activities with coastal zone implications are planned for the African continent in 1998. These include the PACSICOM meeting in Maputo in July (where GOOS will be highlighted), the IOC/LOICZ/START Workshop on Climate Change and Coastal Processes in Cotonou Benin in November, and the GLOSS Training Workshop in Cape Town in November. To help to promote GOOS activity in Africa, it is proposed that the 3rd meeting of the C-GOOS Panel be held in Africa at a location to be decided. This meeting would include a 1-day workshop on coastal processes, data availability, and resources and will help to set the stage for subsequent GOOS related meeting on the Continent in 1999.

It was suggested that the September/October meeting in 1999 should be held in conjunction with EMECS '99 in Turkey. The timing of this would be ideal for launching the HOTO/C-GOOS Black Sea Project. If, for some reason, EMECS '99 should be delayed, Dr Erlich Desa has offered to explore the possibility of hosting the meeting at the National Institute of Oceanography (Dona Paula, India).

ANNEX I

LIST OF PARTICIPANTS

I. CORE COMMITTEE

Larry **Awosika**
Nigerian Institute for Oceanography & Marine Research (NIOMR)
Federal Ministry of Agriculture & Natural Resources Development
PMB 12729 Victoria Island
Lagos
Nigeria
Tel: (234 1) 61 95 17
Fax: (234 1) 61 95 17
e-mail: niomr@linkserve.com.ng

Muriel **Cole**
International Affairs Specialist
Global Ocean Observing System Office (NOAA)
Department of Commerce, Room 5224
14th St & Constitution Ave. NW
Washington DC 20230
USA
Tel: (1 202) 482 2049
Fax: (1 202) 282 5231
e-mail: muriel.cole@noaa.gov

Carlos **Duarte**
Centro de Estudios Avanzados de Blanes (CEAB)
Cami de Santa Barbara
17300 Blanes, Gerona
Spain
Tel: (34 9) 72 336101
Fax: (34 9) 72 337806
e-mail: duarte@ceab.csic.es

Edgardo **Gomez**
Director & Professor
Marine Science Institute
College of Science
University of the Philippines (U.P.)
P.O. Box 1, Diliman
1101 Quezon City
Philippines
Tel: (63 2) 9223921/3959
Fax: (63 2) 924 7678
e-mail: edgomez@msi01.cs.upd.edu.ph

Julie **Hall**
National Institute of Water & Atmospheric Research Ltd (NIWA)
Gate 10, Silverdale Road
Hamilton
New Zealand
Tel: (64 7) 856 1709
Fax: (64 7) 856 0151
e-mail: j.hall@niwa.cri.nz

John **Ogden**
Director
Florida Institute of Oceanography
830 First Street South
St Petersburg, Florida 33701
USA
Tel: (1 813) 553 1100
Fax: (1 813) 553 1109
e-mail: jogden@seas.marine.usf.edu
(unable to attend)

Tom **Malone**
Director & Professor
Horn Point Laboratory
University of Maryland Center for Environmental Science
P.O. Box 775
2020 Horn Point Road
Cambridge, Maryland 21613-0775
USA
Tel: (1 410) 221 8406
Fax: (1 410) 221 8473
e-mail: malone@hpl.umces.edu

Eduardo **Marone**
Centro de Estudos do Mar da (UFPR)
Av. Beira Mar s/n
83255-000, Pontal do Sul, Pr
Brazil
Tel: (55 41) 455 1333
Fax: (55 41) 455 11 05
e-mail: maroneed@aica.cem.ufpr.br

Jozef **Pacyna**
Norwegian Institute for Air Research (NILU)
P.O. Box 100
Instituttveien 18
N-2007 Kjeller
Norway
Tel: (47 63) 89 80 00
Fax: (47 63) 89 80 50
e-mail: jozef.pacyna@nilu.no

Yoshihisa **Shirayama**
Director & Professor
Seto Marine Biological Laboratory
Kyoto University
Shirahama, Wakayama 649-2211
Japan
Tel: (81 739) 42 3515
Fax: (81 739) 42 4518
e-mail: yshira@bigfoot.com

B.R. **Subramanian**
Project Director, Department of Ocean Development
Integrated Coastal and Marine Area Management (ICMAM)
Project Directorate
Koodal Building, Anna University Campus
Chennai - 600 025
India
Tel: (91 11) 235 59 76
Fax: (91 11) 235 59 75

Keith **Thompson**
Dept. of Oceanography
Dalhousie University
Halifax, Nova Scotia, B3H
Canada
Tel: (1 902) 494 3491
Fax: (1 902) 494 2885
e-mail: keith@phys.ocean.dal.ca

Osvaldo **Ulloa**
Programa de Oceanografia Fisica y Clima (PROFC)
Universidad de Concepcion
Casilla 119-C
Concepcion 3
Chile
Tel: (56 41) 203 585
Fax: (56 41) 239 900
E-mail: oulloa@udec.cl

Stephen **Walker**
CSIRO Marine Research
GPO Box 1538
Hobart, Tasmania
Australia
Tel: (61 3) 6232 5298)
Fax: (61 3) 6232 5123)
e-mail: stephen.walker@marine.csiro.au

Mr. Hou **Wenfeng**
Director
National Marine Data and Information Service (NMIDS)
China National Oceanographic Data Center
93 Liuwei Road
Hedong District, Tianjin 300171
People's Republic of China
Tel: (022) 420 12 97
Fax: (022) 430 44 08
e-mail: houwf@bepc2.ihep.ac.cn
(unable to attend)

Sinjae **Yoo**
Marine Ecosystem Dynamics Laboratory
Korea Ocean Research & Development Institute
Ansan, Sa-Dong 1270
South Korea 425-170
Tel: (82 345) 400 6221
Fax: (82 345) 408 5934
e-mail: sjyoo@kordi.re.kr

Adriana **Zingone**
Stazione Zoological 'A. Dohrn'
Villa Comunale
80121 Napoli
Italy
Tel: (39 81) 54833295
Fax: (39 81) 7641355
e-mail: zingone@alpha.szn.it

II. MEMBERS OF OTHER GOOS PANELS

Health of the Oceans (HOTO)

Neil **Andersen**
University of Maryland
Horn Point Environmental Laboratory
2020 Horn Point Road
P.O. Box 775
Cambridge, Maryland 21613
USA
Tel: (1 410) 221 8479
Fax: (1 410) 221 8490
e-mail: andersen@hpel.cees.edu

Ocean Observations Panel for Climate (OOPC)

George **Needler**
Scientist Emeritus
Bedford Institute of Oceanography
1 Challenger Drive
P.O. Box 1006
Dartmouth, Nova Scotia B2Y 4A2
Canada
Tel: (1 902) 426 3145
Fax: (1 902) 426 7827
e-mail: g_needler@bionet.bio.dfo.ca

Dirk G. **Troost**
Chief, Coastal Regions and Small Islands Unit
UNESCO (CSI)
1, rue Miollis
75732 Paris Cedex 15
France
Tel: (33 1) 45 68 39 71
Fax: (33 1) 45 68 58 08
e-mail: d.troost@unesco.org

Tom **Allan**
Satellite Observing System Ltd
Reg Office
15 Church Street
Godalming, Surrey GU7 1EL
United Kingdom
Tel: (44 1483) 42 12 13
Fax: (44 1483) 42 86 91
e-mail: tom@satobsys.co.uk

III. OBSERVERS

Janet **Campbell**
Ocean Biology/Chemistry programme
MTPE/Code YS, NASA HQ
Washington DC 20546
USA
Tel: (1 202) 358 0310
Fax: (1 202) 358 3098
e-mail: jcampbe1@mail.hq.nasa.gov

Elisabeth **Lipiatou**
MAST Programme, European Commission DGXII
Science, Research and Development
Directorate D-RTD Actions:
Environment, Marine Sciences and technologies
Rue de la Loi 200
B-1049 Brussel
Belgium
Tel: (32 2) 296 62 86
Fax: (32-2) 296 30 24
e-mail: Elisabeth.Lipiatou@dg12.cec.be

IV. REPRESENTATIVES OF OTHER BODIES/ORGANIZATIONS

Global Terrestrial Observing System (GTOS)

Jeff **Tschirley**
Director, GTOS
Food and Agricultural Organization of the United Nations (FAO)
Viale delle Terme di Caracalla
00100 Rome, Italy
Tel: (39 6) 5705 3450
Fax: (39 6) 5705 3369
e-mail: jeff.tschirley@fao.org

V. IOC SECRETARIAT

Intergovernmental Oceanographic Commission (IOC)

UNESCO
1, rue Miollis
75732 Paris Cedex 15
France
Fax: (33 1) 45 68 58 12

William **Erb**
Tel: (33 1) 45 68 40 19
Fax: (33 1) 45 68 58 12
e-mail: w.erb@unesco.org

George **Grice**
Tel: (33 1) 45 68 41 89
Fax: (33 1) 45 68 58 12
e-mail: g.grice@unesco.org

(also representing LMR)

Justin **Ahanhanzo**
Tel: (33 1) 45 68 39 90
Fax: (33 1) 45 68 58 12
e-mail: j.ahanhanzo@unisco.org

GOOS Project Office

Colin **Summerhayes**
Director
Tel: (33 1) 45 68 40 42
Fax: (33 1) 45 68 58 12
e-mail: c.summerhayes@unesco.org

Arthur **Alexiou**
Tel: (33 1) 45 68 40 40
Fax: (33 1) 45 68 58 12
e-mail: a.alexiou@unesco.org

Naoko **Ichiyama**
Tel: (33 1) 45 68 39 74
Fax: (33 1) 45 68 58 12
e-mail: n.ichiyama@unesco.org

Yves **Treglos**
Tel: (33 1) 45 68 39 76
Fax: (33 1) 45 68 58 12
e-mail: y.treglos@unesco.org

Janice **Trotte**
Tel: (33 1) 45 68 39 78
Fax: (33 1) 45 68 58 12
e-mail: j.trotte@unesco.org

John **Withrow**
Tel: (33 1) 45 68 40 08
Fax: (33 1) 45 68 58 12
e-mail: j.withrow@unesco.org

Secretariat GOOS Project Office

Ho Hien **Ghalem**
Tel: (33 1) 45 68 39 81
Fax: (33 1) 45 68 58 12
e-mail: hh.ghalem@unesco.org

ANNEX II

AGENDA

Monday 30 March 1998

1. OPENING

2. ADMINISTRATIVE ARRANGEMENTS

2.1 ADOPTION OF THE AGENDA
2.2 DESIGNATION OF A RAPPORTEUR
2.3 CONDUCT OF THE SESSION, LOGISTICS AND ADMINISTRATIVE INFORMATION

3. BACKGROUND INFORMATION

3.1 STATUS OF THE GLOBAL OCEAN OBSERVING SYSTEM (GOOS)
3.2 THE GLOBAL TERRESTRIAL OBSERVING SYSTEM (GTOS)
3.3 THE GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)
3.4 OCEAN OBSERVATIONS PANEL FOR CLIMATE (OOPC) AND ITS RELATION TO COASTAL GOOS
3.5 COASTAL AND SMALL ISLANDS PROGRAMME
3.6 CORAL REEF MONITORING PROGRAMME
3.7 HARMFUL ALGAL BLOOMS (HABs)
3.8 COASTAL INFORMATION SYSTEMS
3.9 LIVING MARINE RESOURCES (LMR) AND ITS RELATION TO COASTAL GOOS
3.10 HEALTH OF THE OCEAN (HOTO) AND ITS RELATION TO COASTAL GOOS
3.11 MIAMI GOOS COASTAL WORKSHOP
3.12 LAND-OCEAN INTERACTION IN THE COASTAL ZONE (LOICZ)

4. EVALUATE & RESPOND TO THE RECOMMENDATIONS OF THE MIAMI WORKSHOP

5. ARTICULATE THE GOALS OF C-GOOS
(Brief presentation by each panel member on their perception of goals, priorities and approaches)

6. DISCUSS AND AGREE ON THE SCOPE OF THE COASTAL GOOS EFFORT

Tuesday 31 March 1998

7. DEVELOP AN ACTION PLAN FOR ACHIEVING THE GOALS OF THE GOOS COASTAL MODULE (Tasks to be completed for the next meeting). **SUGGESTED OBJECTIVES INCLUDE THE FOLLOWING:**

7.1 PREPARE A DETAILED DESCRIPTION OF THE FULL SPECTRUM OF PROBLEMS THAT OCCUR IN THE COASTAL ZONE & DEFINE ECOSYSTEM CATEGORIES ON WATERSHED SCALE
7.2 IDENTIFY THE KEY VARIABLES AND INDICES THAT ARE MOST SENSITIVE TO EXTERNAL FORCINGS AND/OR PORTEND OF SIGNIFICANT CHANGES TO COME
7.3 IDENTIFY "END USERS" AND IDENTIFY POTENTIAL DELIVERABLES OF VALUES TO USER GROUPS; DEVELOP PLANS FOR LINKING PRODUCTS & SERVICES TO ENVIRONMENTAL ISSUES & MEASUREMENTS
7.4 SPECIFY THE VARIABLES THAT SHOULD BE MEASURED & THE APPROPRIATE TIME AND SPACE SCALES FOR MEASUREMENT TO PROVIDE SUCH SERVICES AND PRODUCTS (with rationale for these choices)
7.5 BASED ON A GLOBAL INVENTORY OF COASTAL MONITORING PROGRAMS, VARIABLES MEASURED, SCALES OF MEASUREMENT & RELATED METADATA, DETERMINE GAPS & DEVELOP PLANS FOR FILLING THEM
7.6 DEVELOP A PLAN FOR COORDINATING AND INTERFACING WITH OTHER MODULES (climate, health, living resources) AND RELATED PROGRAMMES (GCOS, GTOS, LOICZ, etc...)

Wednesday 1 April 1998 (0900 to lunchtime)

8. OUTLINE THE STRUCTURE OF A STRATEGIC PLAN AND AN IMPLEMENTATION PLAN FOR THE COASTAL MODULE

8.1 DEVISE MECHANISM FOR IDENTIFYING PILOT/DEMONSTRATOR PROJECTS
8.2 IDENTIFY KEY REGIONS OF INTEREST IN WHICH TO ESTABLISH SUCH PROJECTS

9. FUTURE ACTIVITIES

9.1 INTERSESSIONAL ACTIVITIES, WORK PLAN, TIMETABLE AND RESPONSIBILITIES
9.2 INTERACTIONS WITH OTHER BODIES
9.3 MEMBERSHIP AND COMPOSITION
9.4 RECONSIDERATION OF TERMS OF REFERENCE
9.5 RESOURCES REQUIRED
9.6 SUMMARY OF RECOMMENDATIONS
9.7 DATE AND VENUE OF NEXT MEETING

10. OTHER BUSINESS

11. CLOSURE

ANNEX III

LIST OF DOCUMENTS[1]

Document Code	Title	Item	Language
WORKING DOCUMENTS			
IOC-WMO-UNEP-ICSU/GOOS-CP-I/1 prov.	Provisional Agenda	2.1	E only
IOC-WMO-UNEP-ICSU/GOOS-CP-I/1 Add. prov.	Provisional Timetable	2.3	E only
IOC-WMO-UNEP-ICSU/GOOS-CP-I/3 prov.	Summary Report of the Session (to be prepared during the Session)	9.6	E only
IOC-WMO-UNEP-ICSU/GOOS-CP-I/4 prov.	Provisional List of Documents (this Document)	2.1	E only
IOC-WMO-UNEP-ICSU/GOOS-CP-I/5 prov.	Provisional List of Participants	-	E only
INFORMATION AND REFERENCE DOCUMENTS			
IOC/INF-1091	The GOOS Strategic Plan and Principles		
IOC/INF - 1044	A Strategic Plan for the Assessment and Prediction of the Health of the Ocean: a Module of the Global Ocean Observing System		
IOC/INF - 1062	The Global Coral Reef Monitoring Network Strategic Plan		
IOC Manuals & Guides No.36	Methodological Guide to Integrated Coastal Zone Management		
IOC Workshop Report No.131	GOOS Coastal Module Planning Workshop Report prepared by the Scientific Committee on Oceanic Research of ICSU for J-GOOS, University of Miami, 24-28 Feb. 1997		
GESAMP Reports and Studies No. 61	The contribution of science to integrated coastal management		
	HOTO-IV Report		
	The US Coastal GOOS Report on “The Sustainable Healthy Coasts Component of GOOS”		
	The Coastal Module of the US GOOS: a Strategic Plan		
	LOICZ Science Plan		
	LOICZ Implementation Plan		
	GOOS Newsletter No. 3		
	GOOS Newsletter No. 4		
	WMO Bulletin article on GOOS		

[1] This list is for reference only. No stock of these documents is maintained.

ANNEX IV

LIST OF CURRENT AND POTENTIAL GOOS PROJECTS IN COASTAL AREAS

In developing its strategy, C-GOOS needs to consider its relation to current and possible future GOOS Pilot Projects.

Current Pilot Projects:

(i) NEARGOOS (N.E. Asian region: involves China, Japan, S. Korea, Russia). Primary activity: data exchange in east Asian coastal seas. Future goals: a) modelling as the basis for forecasting; b) addition of more variables.

(ii) EuroGOOS: 30 operational agencies from 16 countries. Primary regional projects: Baltic; Arctic, Northwest shelf (including North Sea); Mediterranean. All variables, but initial focus tends to be on modelling those which are more tractable (physical). Encouraging development of biological and chemical modelling, and collection of data by ferries. Several research projects, totalling 15M Ecu, recently funded by European Commission.

Possible Future Pilot Projects:

(i) PacificGOOS: from Australia/NZ up through Pacific islands to New Guinea. Status: Memorandum of Understanding (MoU) signed between IOC and SOPAC. Officer appointed by SOPAC to see to GOOS development; consultant needed to write strategic plan.

(ii) MEDGOOS: differs from EuroGOOS Mediterranean Forecasting Project: a) in focussing on immediate operations rather than research towards eventual operations; and b) in involving all Med countries. Status: attendees at GOOS Capacity Building workshop in Malta in November 1997 agreed to work with their governments to take MEDGOOS forward. Two regional workshops are proposed as the next step (one eastern and one western Mediterranean).

(iii) BLACKMARS: proposal for Black Sea GOOS, addressing pollution and living marine resource issues. Status: may be taken forward by the Black Sea states operating with IOC.

(iv) SEA-GOOS: South-east Asian seas. Status: the community held a workshop at the IOC WESTPAC Science Conference in February 1998 to discuss the priorities and the mechanisms for taking this forward. A bid is expected to be put to UNESCO in 1998 for start-up funds. An initial focus is the oceanography of the Gulf of Thailand.

(v) WIOMAP: East African coastal states and Western Indian Ocean island states. The WIOMAP concept has been led by WMO (jointly with IOC),and led to a workshop in Mauritius in 1996, at which the concept was refined. A proposal has been submitted for funding.

(vi) Caribbean-GOOS: could begin to spin up late in 1998. Discussions are taking place between IOC and IOCARIBE about how this initiative might be taken forward.

HOTO Priority areas

The geographic areas below, taken from the HOTO strategic plan (table 5), could be targets for regional HOTO pilot projects. They are ranked by the score given in the HOTO plan (table 5), with the highest score indicating the poorest environmental health. The worst cases are given first.

(i) Black Sea (score 37): Comment - a) a possible HOTO Black Sea Pilot Project was suggested at the HOTO Singapore Meeting, 13-17 October 1997; b) there is considerable interest in the Black Sea (see notes above on BLACKMARS project).

(ii) Asian Seas (score 30): Comment - a) a possible N.E. Asian Seas HOTO Pilot Project was suggested at the HOTO Singapore Meeting, 13-17 October 1997; b) there is already a UNEP Regional Seas project (NOWPAP) in the area, to which this might relate; c) this could dovetail nicely with the physical work being carried out in NEARGOOS (above), although the NEARGOOS steering committee does not want to include pollution at this time because it feels it has its work cut out to get the physics working; d) a possible S.E. Asian Seas HOTO Pilot Project was also suggested at the HOTO Singapore Meeting; this could be a focus for SEA-GOOS (see above), when it gets started.

(iii) Great Lakes and Baltic Sea (score 29): Comment - a) GOOS at this time is focussing on salt water not on lakes; b) work in the Baltic is being undertaken under the umbrella of EuroGOOS, and includes extensive pollution monitoring by HELCOM, so a HOTO initiative is not needed.

(iv) Mediterranean and North Sea (score 27): Comment - a) the Mediterranean is being attended to by EuroGOOS and MEDGOOS, but their focus seems to be on the physics of the system, so there may be room to insert a HOTO element - this needs discussion with the MEDGOOS community; b) the North Sea is being attended to by EuroGOOS and by other groupings of North Sea nations, and pollution is addressed through the work of OSPARCOM, so there may be no need for a HOTO initiative here.

(v) Caribbean and West Africa (score 25): Comment - a) there is currently no GOOS activity in either region; b) neither region was discussed in terms of Pilot Projects at the HOTO Singapore Meeting.

(vi) Arabian Gulf (score 20): Comment - was not discussed in terms of Pilot Projects at the HOTO Singapore Meeting.

(vii) Northern Former Soviet Union (score 18): Comment - a possible HOTO Pilot Project in the Arctic was discussed at the HOTO Singapore Meeting.

(viii) Red Sea (score 16): Comment - a HOTO Red Sea Pilot Project was discussed at the HOTO Singapore Meeting.

ANNEX V

SELECTED RESULTS AND RECOMMENDATIONS FROM THE MIAMI WORKSHOP REPORT

1. RATIONALE FOR A COASTAL GOOS (From section 2 of the Miami Workshop Report)

Coastal areas are of immense importance for human habitation and economic activity. Over 50% of the world's population lives on the 3% of the earth's surface area that is defined as coastal. This population percentage is increasing and, if present trends continue, will exceed 70% by 2030, or more than 6 billion people, compared with less than 3 billion today. Most manufacturing and services economic activity occurs in this relatively small area considered coastal. For the United States, the 10% of the country that is in coastal areas is estimated to generate over one-third of the Gross National Product.

Human uses of the ocean are most intense in the coastal zone. One means of quantifying these uses is the economic value associated with various marine-related industries. Several countries including Australia, France, the UK, and the USA have compiled economic data on some of the coastal uses. Some examples can be provided by data from the USA (Culliton, NOAA, 1990; The American Association of Port Authorities; US Census Bureau):

(i) US coastal areas include the most rapidly growing and densely populated counties in the country. The population of Florida will increase by 226% between 1960 and 2010 - from 5 million to 16 million. Nationally, the increase will be almost 60%, from 80 to more than 127 million people.

(ii) The great majority of the world's international commerce moves through coastal waters, with the annual value of such trade just for the United States estimated to be about $571 billion in 1994. Commercial port activities employed 1.5 million americans in 1992.

(iii) Offshore deposits account for a large and increasing fraction of the world's oil and gas production.

(iv) Commercial fishing is generally concentrated in coastal areas where most of the exploitable stocks are found. About 90% of the world's biomass of fish and shellfish occurs in coastal waters. About 60% of the people in developing countries obtain the majority of their protein from fish.

(v) These waters are a focus for recreational activities such as boating, bathing, and fishing. For example, in the USA, recreational fishing was estimated in the early 1990's to contribute $6.2 billion, and recreational boating, $17.1 billion annually to the economy.

(vi) Coastal US states receive about 85% of all national tourism revenues.

N. Fleming (1994) presented an economic case for a Global Ocean Observing System (GOOS) with the following annual estimates in US $:

- offshore oil and gas, $135 billion;
- expenditures for oil and gas rigs and platforms, $45 billion;
- global fisheries, $126 billion;
- maritime transport revenue, $173 billion;
- global marine tourism, $100 billion;
- sales of recreational boats, $20-30 billion;
- marine electronics, $10 billion;
- civil ship building, $10 billion.

These marine-related industries total more than $629 billion per year. Not included in these estimates are the costs of insurance industry in the coastal zone, costs related to waste management, to maintenance of ports and harbors, navigational safety, marine weather forecasting, marine mining, and coastal shoreline protection, maintenance, and development. The coastal element of GOOS can improve the efficiency and reduce the costs of many of these economic sectors.

Beyond the immense direct economic significance of coastal areas is their great value for ecological and aesthetic reasons. Coastal waters contain biologically productive, diverse ecosystems that provide vital habitat for many commercial and endangered species. Wetland and other shoreline areas are extremely important

breeding and spawning areas for many species of fish and other organisms and yet globally over 50% of such areas have already undergone severe environmental degradation. Shoreline areas also take on critical roles as buffers between land and sea. They protect uplands from storms and flooding while at the same time serving as filters to remove pollutants and other materials transported from upland areas before they enter the coastal ocean.

Following preparatory work by the IOC from 1989 onwards, including through the Second World Climate Conference, the signatory parties to the UN Conference on Environment and Development in June 1992 agreed that a Global Ocean Observing System (GOOS) should be established to meet the needs of the diverse uses and interactions of humankind with the marine environment. Working through the IOC, WMO, UNEP, ICSU, and FAO member states have begun to define their requirements for GOOS. This report examines the issues related to the coastal aspects of GOOS. It builds upon previous considerations of the Health of the Oceans (HOTO) and the Living Marine Resources modules of GOOS. The work being done in formulating the EuroGOOS, the NEARGOOS, the US coastal GOOS, and coastal GOOS activities in countries such as Australia, Brazil, India, and New Zealand during the past several years has also been useful in our considerations. We assume that there will be one GOOS; the presently defined “modules” provide a means of defining the requirements to meet various objectives. We also assume that the coastal component of GOOS will have widespread applications for nearly all coastal states. Coastal GOOS involves a large number of cross-cutting issues being considered by the five modules.

In addition to regional activities which are already formally linked to GOOS, the workshop received information on other well-established regional monitoring networks. These activities have also developed a wealth of experience upon which Coastal GOOS should build. A prime example of such an existing monitoring system is CARICOMP, a network of Carribean marine laboratories, parks and preserves which concentrates on Caribbean Coastal Marine Productivity and which was initially supported by UNESCO. CARICOMP might provide a focus for the development of a Coastal GOOS initiative in the Caribbean region. Others such specialized networks include the Global Coral Reef Monitoring Network and “the IOC-UNEP International Mussel Watch” and a mangrove initiative.

Concerns about the deterioration in coastal environments and ecosystems and about resolving conflicts in uses of coastal resources have prompted many coastal states to develop integrated coastal area management programmes. International efforts are underway to focus attention on the need to achieve sustainable management of coastal resources and to preserve marine biodiversity. The coastal component of GOOS will establish a common approach to making the required coastal ocean observations, to achieving inter-comparability among separate efforts within a region and throughout the world, and to producing a set of products that meet user needs.

At present there are many programmes being conducted by countries around the world pertaining to coastal observations and assessments. These programmes include the determination of sea-level variations, the characterization of currents, the provision of marine meteorological forecasts and wave conditions to increase navigation safety, and marine environmental quality measurements. Additional value could be derived from these efforts if the present local and national efforts were more closely linked to provide regional and global consistency and for the compilation and exchange of data and information products.

2. UBIQUITOUS PROBLEMS, CORE VARIABLES AND END-USERS (from section 10 of the Miami Workshop Report)

The Workshop agreed on a provisional list of variables which must be monitored in order to provide appropriate products to the managers of these applications. It is noted that not all the variables are the provenance of GOOS, and some data types will be required from land-based agencies, or are being co-ordinated by GCOS or GTOS.

The Workshop has considered the technologies (see Table 5 from the Miami Workshop Report on the following page), defined the generic end-to-end system within which those technologies will be deployed, and suggested best practice in their use so as to provide reliable information services.

Table 5 (from the Miami Workshop Report): **Proven technologies for continuous/automatic and *in situ* measurements and for routine monitoring**

Variable	***Instrument/System/Platform (Satellite/Buoy)***
Sea level / tides	tide gauges (pressure and acoustic), seabed echosounder (inverted echosounder) satellite altimeter
Meteorological variables, e.g.: air temperature, atmospheric pressure, humidity, wind velocity and direction, solar radiation	land-based observation and data collection platforms, buoys and observation towers with telemetry using VHF, HF and Satellites, ship-borne deck/bridge observations
Extent of sea ice	Synthetic Aperture Radar (SAR) Self Scanning Microwave Instrument (SSMI) and shore-based radar
Photosynthetically available radiation	*in situ* sensors
Wave period, height	wave rider buoys with telemetry, satellite based SAR
Wave direction, frequency spectra	shore-based radar, wave directional buoys with telemetry
Sea Surface temperature	*in situ* sensors, satellite radiometers, drifting buoys
Vertical profile of temperature	XBT
Vertical profile of salinity and temperature	CTD, XCTD
Surface currents	shore-based high frequency radars (e.g., OSCR, CODAR) wind-sea coupled models, ADCP, moored and drifting buoys
Vertical profile of currents	ADCP, current meters
Salinity	*in situ* sensors, discrete samples, buoy mounted sensors
Dissolved oxygen	*in situ* sensors, discrete samples, buoy mounted sensors
Ocean color (surface chlorophyll)	ocean color scanner
Turbidity and suspended sediments	*in situ* sensors, bottom mounted acoustic instruments, satellite optical sensors, moored buoys
Reflectance (oil spill detection)	satellite based radiometers
Precipitation	radar

GOOS design, including the coastal component, is based on the evidence that there are real advantages in carrying out the design at a global level. This evidence includes:

- The understanding that there are ubiquitous processes which can be measured, modelled, and predicted.
- The commonality of problems and applications in the coastal zone as perceived by customers and user groups.
- The recognition that there are global concerns related to global climate change, climate variability and other aspects of global environmental change, both naturally and anthropogenically induced.

Advantages include:

- Available technologies and communications which permit the assembly of synoptic or near synoptic global data sets.
- Economies of scale.
I. Widespread application of best practice.
- Consistent and compatible data sets gathered by different groups permitting the creation of coherent global data sets.

These factors necessitate that GOOS be designed and implemented with full recognition of the need for coherence at the global scale. A future objective of J-GOOS must be to ensure that an agreed set of core variables to be measured in coastal GOOS is defined. Wherever possible the coastal component of GOOS should include sets of core variables which are measured to compatible standards globally or within ecosystems, in addition to local and site-specific requirements. It is one of the duties of J-GOOS to oversee the achievement of this global coherence.

The Workshop considers that the resources, staff, skills, and experience necessary to start the implementation of GOOS in the coastal zone on a phased basis, and to carry out the necessary operational activities, including pre-operational research, do exist at the level of national agencies, and of the large national and regional GOOS programmes. The recommendations of this report are therefore balanced so as to retain the responsibility for global coherence and integration at the level of J-GOOS, while suggesting that the responsibility for detailed design and implementation is most appropriately delegated to the national and regional levels.

The workshop participants identified and discussed a large number of concerns which are ubiquitous in the coastal regions of the world and require global assessments and responses.

Several examples in which a coastal-based ocean observing system will have increasingly valuable benefits include evaluations of sea-level variations, climate change and variability, assessments of trends in occurrences of harmful algal blooms and occurrences of oxygen depletion in coastal waters, and enhanced sustainability of coastal ecosystems such as coral reefs, mangroves, estuaries, barrier islands, and rocky shores.

By addressing these concerns in coastal environments on a global basis there is recognition of the universal nature of coastal physical, chemical, and biological processes, the trans-boundary character of marine problems, and the benefits that can be derived by employing a common set of standards, procedures, and information products.

The potential users and partners in implementing the coastal portion of GOOS include the shipping industry, the oil and gas industry, port and harbor authorities, commercial fisheries, mariculture operations, the re-insurance industry, the tourism and recreation industries, the governmental agencies that support the needs of these marine-related industries, coastal zone managers, regulatory agencies for coastal resources, and the marine science community.

Examples of applications, users, and variables to be measured are given in Table 1 in the Miami Workshop Report (see next page).

GOOS has the objective to measure characteristics of the world ocean and coastal seas so as to produce data and products which have socioeconomic value and environmental benefits. This Report demonstrates that the greater part of these benefits will accrue by application of GOOS products to problems in the coastal zone.

Table 1 (from the Miami Workshop Report): **Examples of problems to be solved (or applications for GOOS) in the coastal zone, variables that need to be measured, and the "stakeholders" or end users of coastal GOOS data and products.**

Applications	***Variables***	***End User***
Disaster Mitigation	Wind, Sea State, Waves, Storm Surges, Tsunamis, Sea Ice, Sea Fog	Local & central gov'ts Transport, Fishing companies Coastal residents & developers Insurance & construction cos.
Fishing	T, S, chlorophyll, Sea State, Currents, Population Biomass, Population Structure	Fishing companies
Mariculture	T, S, Sediment, Water Quality, Nutrients	Mariculture industry
Coastal Development	Wave Statistics, Sea Level, Sea-State, Erosion, Bathymetry, Sedimentation, Riverine Inputs	Design and Engineering cos. Local gov'ts, Insurance cos.
Waste Management	Currents, Winds, Biological and Chemical Variables, Dissolved Oxygen, Water Quality	Dumping companies, Waste producers, Local gov'ts
Harmful Algal Blooms	T, S, Currents, Winds, Species Composition, Nutrients, Rainfall, Continental Runoff, Solar Radiation	Fishery companies, Local gov'ts, Mariculture cos., Insurance cos., Tourism & recreation industry
Human Health Protection	Bacteriological and chemical measurements in seafood, bacteriological indicators in seawater	Health departments and agencies
Pollution	Currents, Water Quality, Oxygen, Toxic Substances, Sediment Composition	Local gov'ts, Coastal developers, Construction industry, Coastal industries
Oil Spills	Currents, Winds, Waves, T, Ocean Color for Surface Slicks	Coast Guard, Clean-up operators, Insurance cos., Tanker cos.
Tourism and Recreation	Weather, Sea-state, Water Quality, Temperature, Solar Radiation, Rainfall	Tourism industry, Local gov'ts
Vessel Traffic	Currents, Winds, Waves, Visibility	Port Authorities, Shipping & Insurance companies
Efficiency of Offshore Operations	Sea State, sea level, currents, ice, sediment transport, wind, pollution parameters	Coastal Industries Offshore Oil companies Port authorities

World-Wide Coastal Zone Issues

- Sea level change.
- Ecosystem deterioration including preservation of biodiversity, the protection of critical habitats such as mangrove forests and coral reefs, the protection of endangered species and the introduction of non-indigenous species to marine ecosystems.
- Eutrophication from nutrient inputs from the watersheds and airsheds affecting the coastal zone.
- Waste management in the coastal zone.
- Harmful algal blooms.
- Threats to human health posed by marine disease vectors.
- Mitigation of natural and human-augmented disasters such as major storms, flooding, and coastal erosion.
- Over-exploitation of coastal fisheries and threats to artisanal fisheries.
- Mariculture management.
- Safe and efficient maritime transport including, port design and management, safety at sea, search and rescue operations, and responses to pollution caused by shipping accidents.
- Effective design and operation of industrial operations in the coastal zone.
- Reduction of the impacts in the coastal zone from non-point sources of pollution.
- Tourism and other recreational uses of the coastal zone.
- Threats to fresh water supplies from salt water intrusion in coastal areas.

3. CAPACITY BUILDING

The strategic design of the Coastal Zone component of GOOS needs to be developed from the perspective of ubiquitous global issues, concerns and required outputs/products. The needs for GOOS, and the benefits to be derived from it, are those enunciated by the international community in terms of economic and social development and environmental protection. These aspirations are partly reflected in multilateral agreements and international conference documents (e.g. Agenda 21).

The workshop noted that the coastal zone components of GOOS, initially developed in response to global issues, will subsequently need to be further developed and refined in the context of specific local/regional circumstances. Many problems in the coastal zone (e.g. eutrophication, habitat loss, storm surges) are especially severe in developing countries, although they may well have a global impact. Thus, in order for Coastal GOOS to be usefully implemented where it is arguably needed most, attention must be paid to the issues of training and capacity building.

If the Coastal GOOS Module is realized in a global sense, and it is planned to be based on a global data acquisition network, all the world's coastal regions must be considered in detail, with their local, regional and global peculiarities. It is impractical to plan a network for data acquisition, processing, analysis and interpretation with any predetermined scales of temporal and spatial resolution on a global level. However, it is essential that the locally-implemented constituents of a global GOOS are consistent with a global perspective so as to achieve regular and comprehensive sampling. For the same reason, the local/regional methodologies used to obtain and to process the data and its quality control, must be of adequate precision and accuracy to meet global standards and requirements.

Once the standards are defined, mechanisms to assure the required network design must be considered.

These points apply particularly to developing countries, where the human resources for coastal studies are sparse or do not exist. To ensure a good world-wide coverage, this problem must be corrected. The other point that must be considered is related to the technology that would be used for data collection, processing and analysis. Such technology must be accessible to all stakeholders, on a low cost basis and in an operational sense. Accordingly, assistance must be provided to help developing countries to raise the initial financial support required for the acquisition and deployment of the necessary devices in selected sites. Maintenance and calibration are other issues that must be considered when dealing with long term operation. For an efficient operation of such a system, a constant flux of technical and scientific knowledge and financial support is essential.

The gaps in the geographical distribution of coastal activities are especially severe in the Southern hemisphere. Regional and National Coastal GOOS projects in these areas must be encouraged, promoting local groups to build their own local and regional programmes, using installed capacity, where possible. On the other hand, strong effort must be applied in the area of education, promoting facilities for medium and high level scientific and technical education for national scientists of these countries. The implementation of a global observation network is only the first step, that will be followed by a long-term operation and maintenance of the data acquisition systems. The necessity of well trained technical and scientific teams needs to be emphasized at all stages of the planning process.

The resulting data bases should be accessible to all participants, and Internet standards for data transmission must be established to facilitate data transfer. Products developed with such data bases should be accessible to all participating countries.

Practical solutions to these problems may be obtained through regional GOOS initiatives, particularly where a region includes both developed and developing countries. In addition, the natural teleconnections induced by oceanic and atmospheric dynamics mean that phenomena occurring in one region may have impacts on other very distant parts of the globe, regardless of national, political boundaries. This provides a rationale for training and capacity building being provided to the developing countries, even on the restricted basis of the self-interest of developed nations.

There is much "aid" which can be provided which costs the donor little but can be very valuable to the recipients in developing countries. Examples of this include:

(i) the provision of training in recipient countries;
(ii) the adoption of a free and open exchange data policy;
(iii) the release of historical data sets;
(iv) the free provision of products/advice in exchange for data from developing countries;
(v) the encouragement, development and use of "consumer" technologies i.e. those that benefit from substantial markets;
(vi) assistance in the establishment of national and regional data centres;
(vii) major modelling centres can run models in domains of interest to developing countries, particularly if such initiatives are accompanied by the provision of scholarships to allow recipient countries to participate in the generation and interpretation of model output.

4. RECOMMENDATIONS

The Workshop recommended the formation of a GOOS Coastal Module Panel, but recognized that many of the recommended actions need not be initiated by or controlled directly by the Panel. Many of these necessary actions can be carried out by the GOOS Support Office, by Regional and National GOOS bodies, by groups of experts, or by consultants. The Panel should oversee and review such activities, without causing delays in urgently required actions. In particular, as regards the coastal zone, J-GOOS itself and the Panel must take into account the vigorous level of national and commercial activity which will proceed regardless of GOOS, and try to integrate these activities in the most efficient way possible.

The Workshop recommends that J-GOOS should:

1. Form a GOOS Coastal Module Panel with the Terms of Reference set out in Annex VII.

2. Ensure that analysis is conducted showing in detail the full range of problems which occur in the coastal zone requiring GOOS services, the urgent issues and requirements for monitoring and information which are the driving reasons for the development of GOOS in the coastal zone, the user groups and categories of industries which are the potential customers, the products which they require, and the variables which need to be measured to deliver those products.

   2a. Facilitate the investigation and definition of sets of core variables appropriate at global and other scales or regimes including recommended degrees of accuracy and resolution.

3. Continue to assess the requirements identified by the other GOOS Modules in the coastal zone, and optimize their integration with the Coastal Module Panel.

4. Promote and encourage the conduct of economic studies in coastal regions to assess the benefits of GOOS regional products, especially in order to identify the services which will be most useful to developing countries.

5. Encourage regional GOOS groups to promote market research on the needs for GOOS coastal products, and establish links with global organizations representing major industries and services in the coastal zone who will be potential users or beneficiaries of GOOS products. Establish working relations with stakeholders in the coastal zone.

6. Encourage regional GOOS groups to develop GOOS Coastal activities which involve the Developing Countries as participants, and promote Capacity Building which will facilitate generation of GOOS products in the coastal zones of Developing Countries.

7. Promote and encourage the development of coastal environmental data services through regional collaboration between Member States and Agencies, and promote the formation of such regional associations in GOOS where appropriate.

8. Encourage the development and testing of new technologies which are designed to meet the requirements of the coastal component of GOOS.

9. The Workshop recommends the following regional initiatives to J-GOOS as initial steps to begin moving the Coastal Module of GOOS forward:

   (i) Endorse or recognize the entities with regional scope represented by NEARGOOS, EuroGOOS, and national initiatives such as India-GOOS and US-GOOS, as appropriate organizational mechanisms for meeting the needs of the coastal component of GOOS.

   (ii) Identify and encourage the formation of similar regional and national entities, and/or the expansion of the existing regional and national entities, in order to achieve the required global scope for the coastal component of GOOS. Examples of regions where Member States and Agencies might consider it appropriate to quickly expand the regional approach include the Black Sea, the Caribbean, the Mediterranean, the South Atlantic, the South China Sea, the Arctic and the South Pacific.

   (iii) Forward this Workshop Report to the existing regional and national entities to provide guidance on the needs of Coastal GOOS, requesting their feedback to the future planning process.

   (iv) Charge those entities with developing practical action plans relevant to the coastal requirements of their regions.

   (v) Review, and when appropriate, endorse those plans, as being scientifically and technically viable and consistent with GOOS objectives. J-GOOS should consider developing a procedure whereby regional plans can be reviewed and, if appropriate, given international endorsement by J-GOOS.

   (vi) Devise and encourage mechanisms for achieving an efficient overall plan for coastal GOOS drawing on the experience of the regional entities, which meets the needs of all GOOS Modules, and in coordination with the other global observing systems and the World Weather Watch.

10. Propose to the GOOS Support Office to establish procedures by which virtually all coastal states can become engaged in the process of designing and implementing the coastal portion of GOOS. These procedures should include the following:

   (i) incorporate into the GOOS World Wide Web site the list of contacts in each country for GOOS overall, and for the HOTO, LMR, Climate, and Coastal Modules of GOOS;

   (ii) incorporate links into the GOOS World Wide Web site links that point to national and regional GOOS planning efforts;

(iii) encourage the dissemination of established and prototype GOOS information products via the World Wide Web.

CONCLUDING STATEMENT FROM THE GOOS COASTAL WORKSHOP

Coastal GOOS derives much of its justification from the increased effectiveness and efficiency with which economic activities can be carried out in the coastal zone. However, as recognized by Chapter 17 of Agenda 21 and elsewhere, important societal goals, such as those set out in treaties and conventions on climate change and biodiversity, and those relating to human health, will also be supported by a coastal GOOS.

There is no doubt that some valuable, albeit limited, progress can be achieved by the better use of existing resources. But, to the extent that governments and agencies wish to reap the benefits of Coastal GOOS and to fulfill their responsibilities identified under UNCED and other agreements of the global community, resources will have to be found for these purposes.

The benefits identified and the recommendations made above, have significance only in so far as the commitments of nations to support the GOOS initiatives are realized.

ANNEX VI

COASTAL GOOS : WHAT IS IT AND WHY DO IT?

The coastal zone from drainage basin to coastal ocean is a mosaic of complex, interacting ecosystems that include terrestrial (watersheds), wetland, freshwater, estuarine and marine habitats. As human populations increase in coastal watersheds, the combined effects of global climate change and human alterations of the environment are expected to be especially pronounced in coastal aquatic ecosystems where inputs of materials and energy from land, sea, air, and people converge. Nutrient and contaminant inputs, the exploitation of living resources, translocation of non indigenous species, and habitat disturbance and loss are among the most ubiquitous and sustained human alterations of coastal ecosystems that are affecting the quality of life and increasing the vulnerability of human populations to natural disasters.

Event scale climatic events and longer term climate change will compound the effects of local and regional human alterations of the environment through sea-level rise and an increase in storm-surge hazards and possible changes in the frequency and intensity of storms. Over the next 100 years, rising sea-level may inundate large areas of coastal wetlands and a significant portion of dry land less than 50 cm above sea-level. In many areas, wetlands and beaches may be squeezed between advancing sea level and engineered structures. Rising sea-level will also raise the base for storm surges and substantially increase the size of the 100-yr flood plain. Assuming current development trends continue, flood damages incurred by properties subject to sea-level rise are projected to increase by as much as 50% for a 30-cm rise and by over 100% for a 90-cm rise. In addition, saltwater is likely to intrude further inland and upstream threatening drinking water supplies, and projected increases in water temperature and changes in freshwater flows are likely to have profound local and regional affects on the biodiversity and productivity of coastal ecosystems.

A recent analysis of “ecosystem services” concluded that their global value, in terms of the cost of reproducing them in an artificial biosphere, is on the order of $30 trillion or nearly twice the cumulative global GNP. In this context, services provided by coastal aquatic ecosystems (Table 1) were valued at $11.4 trillion with terrestrial ($11.1 trillion) and oceanic ($7.5 trillion) ecosystems accounting for the rest. Although such analyses of ecosystem services and current predictions of climate change and its effects are controversial, they underscore the importance and urgency of achieving a more holistic, predictive understanding of the responses of coastal ecosystems to inputs from terrestrial, atmospheric, oceanic, and human sources.

The achievement of such a predictive understanding of coastal ecosystems depends on the development of regional to global networks that link observation and analysis in more effective and timely ways. However, the specific goals and the means of implementing GOOS have been subject to much debate and progress has been slow, largely because implementing the concept of GOOS in the coastal zone requires major changes in the way we do business in two important ways:

(I) The environmental research community in the coastal zone has been too fragmented internally (oceanographers, meteorologists, estuarine ecologists, terrestrial and land-scape ecologists) and too isolated from the community at large. GOOS must work to promote more effective linkages between these groups. In addition, so-called user groups (policy makers, environmental and resource managers, NGOs, the business community, and the public in

general) are not getting the scientific information they need to make informed decisions in a timely fashion. GOOS must work to inform the scientific community of user needs, to inform users of the capabilities of science to provide the information they need, and to ensure that the products of science satisfy these needs.

(ii) With few exceptions, research to document patterns in coastal ecosystems has emphasized observations and experiments on small (local) scales. For logistic reasons, experiments and observations are generally too limited in time a space to provide synoptic information on ecological phenomena across the range of scales that characterize biological and physical variability in coastal ecosystems and their adjacent watersheds and oceans. Even in the age of satellites, we remain stuck in our parochial local ecosystems muddling with the dilemma of whether changes reflect the spatial scale of observation or time-dependent changes *in situ*. This problem is especially acute in coastal ecosystems which are subject to larger scale forcings and have rapid response times relative to terrestrial and oceanic ecosystems and where the notion that every system is unique often dominates the conduct of research and monitoring programmes. The scarcity of observations on coastal ecosystems of sufficient duration, spatial extent, and resolution and the lack of knowledge (theoretical and empirical) on the propagation of variability across scales through and among coastal ecosystems are major barriers to the goals of predicting environmental changes and their ecological consequences.

The ultimate goal of Coastal GOOS is to encourage and support the development and application of nowcasting, forecasting and predictive capabilities as a means of preserving healthy coastal environments, promoting sustainable uses of coastal resources, mitigating coastal hazards, and ensuring safe and efficient marine operations. To these ends, Coastal GOOS should design and implement a strategy that promotes (i) the use of remote and *in situ* sensing technologies and real-time data acquisition and analysis; (ii) more timely exchange of information and knowledge among terrestrial and estuarine ecologists, oceanographers and meteorologist working in the coastal zone; (iii) the development of models to improve the understanding of coastal ecosystem structure and function and to forecast change; (iv) more effective linkages between environmental science and society with the goal of producing products that meet the needs of user groups outside the scientific community; and (v) increased public awareness of the issues, especially as related to the interactive effects of climate change and human activities in the coastal zone.

Table 1. Ecosystem services provided by coastal aquatic ecosystems in rank order of estimated value (Adapted from Costanza, R. et al. 1997. The value of the world's ecosystem services and natural capital. Nature, 387: 253-260.).

Rank	Ecosystem Service	Ecosystem Functions	Examples
1	Nutrient Cycling	Nutrient storage & processing	N fixation, nutrient cycles
2	Waste Treatment	Removal, breakdown of excess nutrients & contaminants	Pollution control, detoxification
3	Disturbance Regulation	Buffer impact of climatic disturbances	Storm protection, flood control, drought recovery
4	Recreation	None	Boating, sport fishing, swimming, etc.

Rank	Ecosystem Service	Ecosystem Functions	Examples
5	Food Production	Portion of PP extractable as food	Fish harvest
6	Refugia	Habitat, biodiversity	Nurseries, resting stages, migratory species
7	Cultural	None	Aesthetic, artistic, spiritual, research
8	Biological Control	Trophic dynamics, biodiversity	Keystone predator, pest control
9	Raw materials	Portion of PP extractable as raw materials	Lumber & fuel
10	Gas Regulation	Chemical composition of the atmosphere	CO_2, O_3, SO_x

ANNEX VII

TERMS OF REFERENCE AND OBJECTIVES OF THE COASTAL MODULE COORDINATING/OVERSIGHT PANEL

TERMS OF REFERENCE

1. The Panel is initially appointed for two years, and shall report to each meeting of the GOOS Steering Committee (GSC). Every session of the GSC should rigorously assess the progress of the Panel and review its membership.

2. The membership of the panel shall, in the first place, be based on informal suggestions from the GOOS Coastal Module Workshop held in February 1997, combined with recommendations from existing members of GSC, and inquiries by the chairman of GSC. The membership shall represent an appropriate range of professional skills, experience of coastal monitoring and forecasting, and representatives of organizations and agencies who are users of operational marine data, or providers of operational marine environmental services.

3. The chair of the panel shall be appointed by, and report to, the chairman of the GSC.

4. Meetings, publications, and other activities incurring costs, shall be planned in consultation with the GSC, the GPO, and the GOOS sponsor agencies.

5. The panel can be re-appointed, and the terms of reference and objectives may be reviewed and revised at any meeting of the GSC, but only for a period of one year on each occasion, or until the next meeting of the GSC, whichever is the longer.

OBJECTIVES

1. To review progress, advise, and report upon those activities of GOOS component bodies, the GOOS Project Office, and participating member states and agencies, which relate to production and delivery of marine environmental data products and services in the coastal zone.

2. To promote and encourage GOOS activities in the coastal zone.

3. To provide guidance and advice to the GSC on matters concerning the coastal zone.

4. To communicate with other GOOS module panels, to ensure that the activities of the GOOS coastal panel are carried out in such a way as to maximize the effectiveness of GOOS as a whole, taking into account the requirements specified by other panels or components of GOOS.

5. To communicate with other agencies, committees and programmes on behalf of the GSC, where there are necessary adjacent boundaries, requirements for exchange of data, or adoption of common procedures or policies.

6. To provide exchange of information among the national and regional GOOS planning efforts in the coastal zone so that a globally consistent template for the coastal module will emerge.

7. To develop the Coastal Module Implementation Plan.

ANNEX VIII

LIST OF ACRONYMS

CAOS	Coordinated Adriatic Observing System
CARICOMP	Caribbean Coastal Marine Productivity
C-GOOS	Coastal GOOS
CEOS	Committee for Earth Observation Satellites
CLIVAR	Climate Variability and Predictability
CPR	Continuous Plankton Recorder
CSI	Coastal Regions and Small Islands
EEZ	Exclusive Economic Zone
EMECS	Environmental Management of Enclosed Coastal Seas
EuroGOOS	European GOOS
FAO	Food and Agricultural Organization
FSU	Former Soviet Union
GCOS	Global Climate Observing System
GCRMN	Global Coral Reef Monitoring Network
GIPME	Global Investigations of Pollution in the Marine Environment
GLOBEC	Global Ocean Ecosystem Dynamics
GLOSS	Global Sea-Level Observing System
GNP	Gross National Product
GODAE	Global Ocean Data Assimilation Experiment of the OOPC
GOOS	Global Ocean Observing System
GOSSP	Global Observing System, Space Panel
GPA	Global Plan of Action for the protection of the marine environment from land-based activities
GPO	GOOS Project Office
GSC	GOOS Steering Committee
GTOS	Global Terrestrial Observing System
G3OS	Global Observing Systems (GOOS, GCOS & GTOS)
HABs	Harmful Algal Blooms
HELCOM	Helsinki Commission
HOTO	Health of the Oceans
ICES	International Council for the Exploration of the Sea
ICRI	International Coral Reef Initiative
ICSU	International Council of Scientific Unions
IGBP	International Geosphere-Biosphere Programme
IGOS	Integrated Global Observing Strategy
IOC	Intergovernmental Oceanographic Commission
IOCCG	International Ocean Colour Coordinating Group
J-DIMP	Joint Data and Information Management Panel
JGOFS	Joint Global Ocean Flux Study
LME	Large Marine Ecosystem
LMR	Living Marine Resources
LOICZ	Land-Ocean Interaction in the Coastal Zone
LTER	Long-Term Ecosystem Research Programme
MARPOLMON	Marine Pollution Monitoring Network
MEDGOOS	Mediterranean GOOS
MTS	Marine Technology Society
NASA	National Aeronautical & Space Agency
NEARGOOS	North-East Asian Regional GOOS
NGOs	Non-governmental Organizations
NOAA	National Oceanic and Atmospheric Administration (USA)
NSF	National Science Foundation
NOWPAP	Pacific Action Plan
OOPC	Ocean Observations Panel for Climate
OOSDP	Ocean Observing System Development Panel
OSPARCOM	Oslo and Paris Commission
PACSICOM	Pan-African Conference on Sustainable Integrated Coastal Zone Management
PICES	North Pacific Marine Science Organization
SIDS	Small Island Developing States
START	Global Change System for Analysis, Research and Training
TAO	Tropical Atmosphere Ocean Array
TEMA	Training, Education and Mutual Awareness
UNEP	United Nations Environment Programme
WCRP	World Climate Research Programme

WIOMAP Western Indian Ocean Marine Applications Project
WMO World Meteorological Organization