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1. OPENING

The meeting was opened at 0915 on October 30th by Eduardo Marone, Chairman of the local organizing committee, who welcomed the participants (Annex I) to the Federal University of Parana.

Tom Malone, Chairman of the Coastal Panel of GOOS (C-GOOS), thanked the panel members for coming and gave a special welcome to observers from Argentina, Brazil, Colombia and Uruguay; to Tim Kasten representing the United Nations Environment Programme (UNEP); to Dale Kiefer representing the Global Terrestrial Observing System (GTOS); to other observers; to Johannes Guddal representing the World Meteorological Organization (WMO) and the *ad hoc* Services Panel of GOOS; to Eva Maria Koch, who served in place of Carlos Duarte and was invited to present a pilot project on seagrasses; to Tony Knap, new chair of the Health of the Oceans (HOTO) Panel of GOOS; and to Wang Hong and John Ogden, panel members who were attending their first C-GOOS meeting. Apologies were noted from Elisabeth Lipiatou, Carlos Duarte, and Yoshihisa Shirayama.

The panel appreciated the assistance of the Federal University of Parana in making its facilities available for the meeting and the work of Eduardo Marone whose efforts in organizing the venue and providing technical and administrative assistance made the meeting possible.

The Director of the GOOS Project Office (GPO), Colin Summerhayes, welcomed participants to the meeting on behalf of the Executive Secretary of the Intergovernmental Oceanographic Commission (IOC), and on behalf of the other sponsors of GOOS - the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP), and the International Council for Science (ICSU). He thanked the IOC, UNEP, the National Oceanic and Atmospheric Administration (NOAA) of the USA, the Third World Academy of Sciences (TWAS), the Government of Holland, and the Swedish Development Agency (SIDA-SAREC) for their generous financial support for the travel and subsistence of participants. Finally, he gratefully acknowledged the co-operation of the Executive Committee of GOOS Brazil.

T. Malone reviewed the priorities of the C-GOOS Panel as agreed to at its first meeting (C-GOOS-I, 30 March - 1 April, 1998) and outlined the primary goals of this Panel meeting (C-GOOS-II) as follows:

(i) identify programmes that are a high priority for C-GOOS to collaborate with;
(ii) review and specify procedures for developing C-GOOS projects;
(iii) discuss proposed pilot projects; and
(iv) develop an action plan for preparing the C-GOOS Strategic Plan (a draft of which is to be completed at C-GOOS-III).

2. ADMINISTRATIVE ARRANGEMENTS

Julie Hall was elected Rapporteur for the meeting. E. Marone explained meeting logistics, and T. Malone noted that the agenda will likely change in response to the group's deliberations and desires. The final agenda developed during the course of the meeting is given in Annex II. Most background documents (Annex III) were provided by the GPO and by E. Marone via e-mail before the meeting. Extra copies and new documents were made available at the meeting.

3. OVERVIEWS AND BACKGROUND INFORMATION

3.1 UPDATE ON COASTAL GOOS (C-GOOS) ACTIVITIES

3.1.1 Publicizing C-GOOS (Malone)

Actions include the following: (i) presentation on C-GOOS at the July meeting of The Oceanography Society meeting in Paris; (ii) reports in newsletters of science societies and coastal management groups (Bulletin of the American Society of Limnology and Oceanograpy, Estuarine Research Federation NewsLetter, InterCoast Network); (iii) a publication in EEZ Technology (1998), edition 3 ; (iv) special sessions on C-GOOS at international meetings of the Marine Technology Society (Baltimore, MD, 16-19 November, 1998), the American Society of Limnology and Oceanography (Santa Fe, NM, 1-5 February, 1999), and Estuarine Research Federation (New Orleans, LA, 27- 30 September, 1999); (v) involvement of C-GOOS into a proposed new IOC-SCOR programme Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB); (vi) collaboration with Italy, Slovenia and Croatia to initiate the design of the Coordinated Adriatic Observing System

(CAOS); and (vii) a coordination between C- GOOS and a project of the U.S. National Association of Marine Laboratories (NAML) to develop a coastal monitoring network for the U.S.

3.1.2 GOOS Steering Committee (GSC) (Summerhayes)

The results of C-GOOS-I were presented at the first meeting of the GSC in April 1998. The GSC was pleased with the progress made at C-GOOS-I and endorsed the intersession action plan. In addition, the GSC made the following recommendations:

(i) meet twice a year to keep momentum going;
(ii) invite a representative of the GTOS to attend C-GOOS Panel meetings to ensure coordination and collaboration;
(iii) consider specific user needs at future C-GOOS Panel meetings;
(iv) ensure coordination and collaboration with other GOOS Panels including HOTO, Living Marine Resources (LMR) and the Ocean Observing panel for Climate (OOPC);
(v) consider merging the designs of C-GOOS, HOTO and LMR into a single coastal module once the design phase of each is complete;
(vi) develop indicators of environmental change that will be helpful to users;
(vii) explore ways to coordinate better with the UNEP Regional Seas programme.

It was noted that The GOOS 1998 will soon be published and that a 2-page flyer that describes GOOS is now available (in English, French and Spanish) to facilitate wider communication of the aims of GOOS. The flyer is available in hard copy and on the GOOS web site **[http://ioc.unesco.org/goos]**. The web site also has the latest GOOS reports including those of C-GOOS-I and GSC-I and the latest GOOS Newsletters (issues 3, 4, and 5).

The GPO is currently understaffed due to the departure of personnel. A search is underway to employ four individuals who will be responsible for the three advisory panels (Coastal, LMR, and HOTO), the Global Sea-Level Observing System (GLOSS), and GOOS data and information management.

3.1.3 Integrated Coastal Area Management (ICAM) (Summerhayes and Awosika)

The IOC plans to enhance its programme on Integrated Coastal Area Management (ICAM). Given its role, C-GOOS and ICAM should be closely linked. The ICAM-GOOS linkage was effective in the programme of the Pan African Conference on Sustainable Integrated Coastal Management (PACSICOM) in Maputo in July, 1998 (see 3.3). A Group of Experts which met at the IOC (Paris, October 21-23, 1998) to discuss and make recommendations on the future development of ICAM accepted the arguments made by Larry Awosika and Colin Summerhayes that C-GOOS should be an integral part of the ICAM programme.

The IOC signed a Memorandum of Understanding with the International Geographical Union (IGU) to develop a joint GOOS-ICAM-IGU programme to develop (i) a Marine Scientific and Technological Information System for ICAM, and (ii) a Coastal and Deep Ocean Monitoring System for ICAM. Both would require the co-operation of C-GOOS, and both would assist in the development and implementation of C-GOOS.

Item (i) (see 3.4) includes (i) an Internet information system on marine science and observations in support of ICAM; (ii) CD-ROM marine science data sets in support of ICAM; (iii) a world coastal management programmes data bank; and (iv) a coastal GIS data bank. Outputs will be databases in printed form, on CD-ROM, and on the Internet.

Item (ii) (see 3.2 and 5.0) would involve (i) development of stress indicators for coastal marine environmental monitoring; (ii) developing marine scientific evaluation methods for indicators; (iii) developing cost-benefit analyses of coastal monitoring systems; and (iv) meetings to coordinate the design and development of coastal monitoring systems for ICAM. Outputs will be indicators of the health of the environment, improved monitoring systems, and cost-benefit case studies.

3.2 INDICATORS OF ENVIRONMENTAL CONDITION (Summerhayes)

Agenda 21 calls for the development of 'simple' indicators of environmental conditions, to assist policy making and the management of sustainable development. "Indicators of Sustainable Development: Framework and Methodologies" (UN Commission on Sustainable Development, CSD, August 1996) gives examples of indicators and explains how new ones might be created. The following five indicators were given for marine environment:

(i) population growth in coastal areas;
(ii) discharges of oil into coastal waters;
(iii) releases of nitrogen and phosphorus to coastal waters;
(iv) maximum sustained yield for fisheries; and
(v) algae index.

Of these, (iii) and (iv) are listed as complete; (i), (ii) and (v) are listed as being in the development stage. Clearly, considerable work needs to be done to develop a range of indicators for the health of coastal seas.

The CSD is now reviewing progress by governments in implementing the recommendations of each chapter of Agenda 21. In 1999 it will review progress under Chapter 17, on Seas and Oceans.

In developing a design for a coastal observing system, the C-GOOS panel should identify appropriate environmental indicators of the condition (health) of coastal waters that may be used at the next CSC meeting (18 April, 1999).

The related issues of indicators of environmental condition and ecosystem health will be discussed at the Oceans Conference (London, December, 1998). It was also noted that the a Presidential Commission in the U.S. (Committee on the Environment and Natural Resources) is in the process of developing a "report card" that will consist of indicators of the health of estuarine and marine ecosystems. A similar effort is underway for coral reefs. These efforts may be useful to the definition of indicators by the C-GOOS Panel.

3.3 GOOS-AFRICA (Awosika)

The GOOS workshop, which was conducted as part of the PACSICOM meeting (see 3.1.3), focused on the role of C-GOOS in the development of ICAM in Africa. This led to recommendations to (i) form National GOOS Coordinating Committees to improve the effectiveness of the national institutional infrastructure in support of operational oceanography and marine meteorology; and (ii) support sustainable integrated coastal management in Africa as follows:

(i) Form a network of National Ocean Data Centres that are properly equipped and staffed by trained personnel. A high priority should be to rescue in digital form environmental data on African coastal waters that can be used to build the information base required for local and regional coastal planning.

(ii) Upgrade and expand the African network of sea-level stations, and train the technical professionals manning those stations in the analysis and interpretation of the data as a means of providing the data required to advise decision makers on the potential hazardous and costly changes caused by sea-level rise.

(iii) Form a network of specialists trained in the use of remotely sensed ocean data from space satellites, and ensure increased access to regional satellite receiving stations as a means of providing coastal managers with information on land-use patterns in coastal watersheds and the condition of coastal waters (colour, SST).

(iv) Promote effective communications by increasing access to modern electronic communication and data transfer systems (i.e., the Internet) for more effective coastal zone management.

A GOOS-AFRICA Coordinating Committee was formed to work with national, regional and international GOOS groups and funding agencies to help achieve these goals and to facilitate the development and implementation of GOOS in Africa. Larry Awosika, who sits on both the GOOS-AFRICA committee and the C-GOOS Panel, will coordinate the activities of GOOS-AFRICA and C-GOOS. It was noted that holding C-GOOS-III in West Africa will provide the opportunity to link it with a GOOS-AFRICA workshop much in the same way the C-GOOS User's Workshop was linked to C-GOOS-II in Curitiba (Annex IV).

Subsequent discussion focused on the capacity of African countries to contribute to and benefit from GOOS. The survey of African capabilities by the African participants at the PACSICOM meeting indicated widespread shortfalls in national capabilities to collect, manage and process data and to produce products needed by coastal managers and other decision makers. In addition to weak collaboration between nations, there is often little co-operation within individual nations between the different departments that deal with different aspects of marine affairs. Part of the problem is the cost of access to the Internet . Participants agreed that this is a global problem not unique to Africa. PACSICOM revealed the need for and for more effective co-operation and collaboration, and it is hoped that continuation of the PACSICOM process will help to achieve these goals. There will be a follow-up meeting in Cape Town to decide how to continue the PACSICOM process.

3.4 GLOBAL INVENTORY OF COASTAL DATA AND PROGRAMMES (Summerhayes)

The GPO has been asked by several groups (C-GOOS and LMR Panels, ICAM, IODE, IGU) to develop an inventory of existing coastal monitoring programmes. Clearly there is a widely felt need for such an inventory, creation of which may well prove valuable to IOC Member States. In order for the IOC to do this in a timely manner, and given that IOC is currently understaffed, it may be necessary to hire a consultant to carry out the work over a short period. This has been endorsed by the IOC Executive Council (November 1998).

In preparation, the GPO has identified a number of possible sources of information, including: (i) LOICZ; (ii) NEAR-GOOS; (iii) WIOMAP (Western Indian Ocean Marine Applications Project); (iv) PacificGOOS; (v) MedGOOS; (vi) EuroGOOS; (vii) ICES (International Council for the Exploitation of the Sea); and PICES (the Pacific ICES). There is also the growing database on key marine ecosystem health indicators being undertaken by HEED (the Health, Ecological and Economic Dimensions of Global Change Programme) (see **http://heed.harvard.edu).** It was also noted that private foundations have recently examined global ocean data bases that may be useful for understanding and monitoring the health of the ocean and may be interested in funding such an effort..

3.5 IOC DESIGN FOR COASTAL MONITORING SYSTEM (Summerhayes)

In 1990-1991 the IOC and UNEP developed a proposal for a Global Coastal Monitoring System that focussed on the effects of climate change on coastal seas (Annex V; attachments available from the GPO). Six pilot projects were proposed and are discussed below.

(i) *Sea-level and Coastal Flooding*: The Panel agreed that it would be useful to invite the Chairman of GLOSS to C-GOOS-III and for C-GOOS to be represented at the next meeting of the GLOSS Group of Experts (Toulouse, 10-14 May, 1999) to discuss common interests and the development of joint projects, especially projects such as the forecasting of storm surges in the Bay of Bengal (7.2.4).

(ii) *Coastal Circulation*: Consider once the design plan for C-GOOS has been completed.

(iii) *Organic Carbon Storage in Coastal Seas*: Consider at C-GOOS-III as part of the collaboration with LOICZ.

(iv) *Plankton Community Structure*: This will be considered as part of the proposed global network component of C-GOOS (PhytoNet, 7.2.3).

(v) *Coral Reefs*: This is an established project (GCRMN, 5.3).

(vi) *Mangroves*: The loss of mangrove tidal wetland habitat is a major problem and should ultimately be addressed as a part of C-GOOS. The Panel recommends that an expert on mangrove habitats be invited to C-GOOS-III.

The 1990 proposal also suggested that vertical temperature stratification of the upper water column may be a useful index of the effects of global climate change and recommended approaches and properties that should be measured for monitoring coastal circulation (attachment D, Annex V), e.g., surface fields and vertical profiles of salinity and temperature and modelling. These recommendations will be considered by the working group charged with formulating the plan for the proposed global C-GOOS network during intersession.

3.6 GOOS SERVICES MODULE (Guddal)

The role of the *ad hoc* Services Panel of GOOS is to assist the other modules in developing, improving and providing services and products to user groups. An initial survey of existing services and products was completed in 1997 and presented to I-GOOS-III (report available from the GPO). The present thrust is towards creation of a GOOS Services and Products Bulletin in which developments in GOOS can be published alongside articles by users about their GOOS-related services and products. The Panel agreed that a Bulletin might well be a useful way to identify and promote C-GOOS products. Furthermore, given the end-to-end design specified by GOOS, the Panel recognized the benefits of continued advice from the Chairman of the *ad hoc* Services Panel in completing the C-GOOS design and in deciding on what sorts of products and services could be developed to meet users' needs.

3.7 DEVELOPING FUNCTIONAL LINKAGES AMONG SCIENTISTS AND USER GROUPS (Ehler)

The report (Annex VI) emphasizes the importance of involving all stakeholders from the beginning. In this context, there is a clear need to better inform the scientific community of the information needs (including the timely dissemination of and access to data and information). Depending on the nature of the issue at stake, stakeholders (user groups) include (i) representatives of government at all levels; (ii) major economic interest groups ranging from industry to tourism; (iii) scientists from academic and government laboratories; (iv) environmental non-governmental organizations (NGOs); (v) public interest groups; (vi) indigenous and/or subsistence user groups; and (vii) other knowledgeable professionals.

Upfront input from stakeholders should include (i) a clear definition of user group needs, (ii) evaluation of the potential suite of measurements and products in terms of feasibility and user needs, and (iii) identification of funding sources.

Effective end-to-end linkages require appreciation of obstacles arising from cultural differences that give rise to poor communications, misunderstandings, misuse of data and related products, and conflict and competition rather than co-operation. These can be overcome by providing mechanisms to improve understanding and communication, building the capacity for scientist-user interactions, employing appropriate management strategies (e.g., for integrating policy and science capabilities), and allocating resources (e.g., for translating and disseminating scientific results in a 'user-friendly' format). In this regard, C-GOOS should become more involved in coastal management conferences such as the 1999 U.S. Coastal Zone Management Conference.

4. **REGIONAL ISSUES** (Marone)

Eduardo Marone presented the results of the Workshop on a Regional Network on a Natural Hazards Warning System, which took place in Curitiba on October 26-28th 1998 (Annex VII). The objective of the workshop, which brought together a selection of scientists and representatives of operational agencies from South America, was to discuss present operational capacities in the region as the basis for developing a regional information network that could lead to a regional operational system for warnings on natural hazards.

The main results of the meeting are that the participants agreed to form such a network, and that plans are in hand to develop a Web page to facilitate communication between them and others about how to take forward the concept of the warning system (Annex VII). The Web page address is: http://redsur.listbot.com; or at http://www.cem.ufpr.br/fisica/quijote.htm.

Panel members noted that the IOC, in concert with the EU, had recently launched an oceanographic network for South America, and advised Eduardo to ensure that the activity he described was linked effectively to the activities of the IOC-EU network, not least to exploit the efforts and resources that had gone into building it, and the opportunities that it presented for widening collaboration and obtaining resources. The IOC also has a HAB network for South America, and this too should be exploited.

Panel members asked that meteorological services be invited to join the network, while recognizing that present meteorological data were not always useful for coastal predictions because most meteorological stations were located at airports and not on coasts. Navies should also be invited to participate, since they commonly held much of the environmental data needed to make the system work effectively, though it was recognized that navies were often reluctant to share data with others for reasons of national security. Here there is a general role for GOOS to encourage navies to release more environmental data. There will also be the need for a substantial data archaeology effort.

5. **RELATIONSHIPS WITH OTHER PROGRAMMES**

The context of C-GOOS and its relation to other programmes was reviewed in a background paper by Tom Malone (Annex VIII).

During the course of this session, some panel members expressed concern that C-GOOS might have little if any role to play given the plethora of programmes that appear to have similar goals. Tom Malone explained that many of the existing international activities are either paper exercises for the most part or are limited in scope (in terms of the measurements made, temporal and spatial extent, the products produced, or do not meet the end-to-end criteria of GOOS), or both. The role of C-GOOS is to create a design for a comprehensive, fully integrated global observing (and forecasting) system that meets the needs of multiple user groups in a cost-effective way and to insure that all nations have the opportunity to participate in its implementation. C-GOOS is unique in being conceived as an integrated, hierarchical structure of networks, from synoptic remote and *in situ* sensing to data dissemination, visualization and prediction. It is the next generation of all existing systems, and embodies a new paradigm of multi-disciplinary coordination and collaboration among: (i) research, monitoring, assessment and management activities; (ii) marine, atmospheric and terrestrial scientists; (iii) local, state, federal and international institutions; (iv) the scientific community, private industry and the public; and (v) conservation and economic development groups. The challenge is large, but the benefits of success are enormous. As a first step in meeting the challenge, the Panel must become familiar with current and past efforts and plans. With the completion of C-GOOS-II, this phase will have been completed for the most part, and the Panel can focus its attention on the design and implementation of C-GOOS.

5.1 OTHER GLOBAL OBSERVING PROGRAMMES (Malone and Summerhayes)

The four GOOS Module Panels (C-GOOS, OOPC, HOTO and LMR) are charged with (i) developing strategic design plans; (ii) planning and implementing pilot projects as proof of concept, operational demonstrations; and (iii) formulating implementation plans. Pilot projects are also intended to stimulate the development of new technologies (e.g., sensors, telemetry, data assimilation and model development). Successful pilot projects may also become the pillars of C-GOOS. C-GOOS will be implemented through nationally organized initiatives (e.g., Brazil GOOS and U.S. GOOS), through regional programmes (e.g., EuroGOOS, NEAR-GOOS, and the UNEP Regional Seas Programme), and through international initiatives (e.g., GLOSS and the GCRMN). C-GOOS strategic and implementation plans will incorporate plans and recommendations from the OOPC, HOTO and LMR Panels as appropriate, and pilot projects may be initiated jointly with other Panels and programmes.

GTOS also has a coastal component, but its coastal zone subcommittee is currently inactive. As GTOS begins to draft design and implementation plans, collaboration with C-GOOS will be necessary.

5.1.1 Ocean Observing Panel for Climate (OOPC)

The goals of the OOPC are to (i) monitor, describe and understand the physical and biogeochemical processes that determine ocean circulation and its influence on the carbon cycle, and the effects of the ocean on seasonal to multi-decadal climate change; (ii) provide the observations needed for the prediction of climate variability and climate change; and (iii) develop the Global Ocean Data Assimilation Experiment (GODAE).

GODAE is a pilot project designed to assist in implementing the Global Climate Observing System (GCOS) with GOOS addressing the role of the oceans. The purpose of GODAE is to demonstrate the value of integrating satellite and *in situ* data, of model assimilation, and of the global approach. In terms of C-GOOS, GODAE is needed to improve local-regional forecasts of weather and natural hazards. In a project called ARGO, the GOOS will employ a network of profiling (PALACE) floats (1 per 300 square kilometres) capable of obtaining a vertical profile of temperature and salinity from 2000m depth to the surface every 14 days and of lasting for about 4 years (providing 100 profiles). The floats would be more or less evenly distributed over the whole ocean enabling full global coverage of the ocean interior for the first time. Testing will be conducted over the next 3-4 years with full scale deployment planned for 2003-2005.

The OOPC emphasizes the importance of further studies on the coastal-open ocean interface and welcomes the opportunity to develop joint projects with C-GOOS. The GSC has formed an inter-sessional group (chaired by Ehrlich Desa with Ilana Wainer and Mike Fogarty) to examine options for taking advantage of GODAE within the broader context of GOOS, including its relation to non-physical components, regional models and applications, and outreach to entrain developing countries.

The effects of meteorological events, large scale climate change and oceanic processes on coastal ecosystems are clearly important to C-GOOS. In addition to co-operating with the OOPC and the inter-sessional group referred to above, C-GOOS will coordinate its activities with the SCOR Working Group on Coupling Winds, Waves and Currents in Coastal Models (co-chaired by Norden Huang and Chris Mooers). The Working Group will examine critical issues related to coupling between wind forcing, surface waves, and currents in the coastal ocean, and review existing observational data to define future needs for understanding the coastal region as a whole. The focus of the Working Group will be on issues related to the development of a coupled wind-wave-circulation model for assessing the health of the coastal environment and estimating the role of coastal waters in global ocean dynamics.

The effects of oceanic processes and climate on coastal ecosystems should be a major agenda item at C-GOOS-III.

5.1.2 Health of the Ocean (HOTO) Panel (Knap)

The HOTO strategic plan is outlined in Annex IX. Implementation is beginning under the auspices of the GSC and GIPME (Global Investigation of Pollution in the Marine Environment). Implementation is intended to occur region by region through the application of pilot projects, one of which (RAMP) has begun (see below). As articulated in the strategic plan, HOTO's primary goals are to provide information on the distribution and effects of anthropogenic contaminants, pathogens and toxins of natural origin (e.g., those produced by harmful algal blooms). C-GOOS and HOTO have many areas of common interest and joint projects are encouraged. Key features that are especially relevant to C-GOOS include the following:

(i) Data collection, bio-monitoring and assessments of biological effects are to be conducted on regional-global scales using commonly agreed-upon standards and methods. Initial emphasis will be on developing reliable biological indicators of ecosystem health; monitoring contaminant loadings in relation to ecological responses; developing models for evaluating the assimilation capacity of coastal ecosystems for contaminant loads; and assessing available data on contaminant levels and biological responses to establish regional and national baselines and mass balances (budgets).

(ii) The plan defines priority issues and identifies classes of contaminants to be addressed by GOOS (Annex IX). Although the listing is incomplete, this approach provides a means of prioritising HOTO efforts.

(iii) The plan calls for biological indices of contaminant stress to be identified at molecular, organismal, population and community levels of biological organization. Indices are categorized based on their use, i.e., those needed for management decisions that are driven by the needs of customers who require interpretative products; those required to capture responses to changes in patterns of loading and physical forcing; those required to resolve the effects of substances that are derived from both natural and anthropogenic sources. Measurements are evaluated in terms of their feasibility or cost and their impact on or importance to these uses.

The C-GOOS panel has adopted many of these approaches in designing the coastal component of GOOS, e.g., the feasibility-impact analysis.

One pilot project is underway (RAMP, Rapid Assessment of Marine Pollution). It is intended to provide equipment and training for easy to use, inexpensive technologies to measure chemical and biological markers needed to assess environmental impacts and improve environmental management. The pilot test is taking place in the Brazilian coastal zone. In addition, pilot projects have been planned or discussed for: (i) the Red Sea; (ii) southeast Asia; (iii) northeast Asia; (iv) Arctic; (v) Antarctic; (vi) Black Sea; and (vii) Caribbean. The northeast Asian HOTO pilot project may be implemented by NOWPAP (Northwest Pacific Action Plan, a Regional Seas programme) as a component of NEAR-GOOS. Joint projects of C-GOOS are being considered for the Adriatic, the Caribbean and the Black Sea (section 7.2).

The next step in HOTO planning will take place at a GIPME-HOTO meeting in December 1998, which will develop a plan for the next phase of HOTO. A full panel meeting is planned for 1999 in conjunction with workshops on modelling and indicators of sustainable development. The Panel will be placing increased emphasis on oceans and human health and on improving methods for assessing ecosystem health.

5.1.3 Living Marine Resources (LMR) Panel

The LMR Panel is working to draft the design strategy and implementation plan for documenting changes in living marine resource and predicting changes in abundance and distribution. In the first instance, the Panel will focus on oceanic systems and the coastal ocean (open waters of the EEZ) leaving estuarine, coral reef, seagrass and tidal wetland (e.g., mangrove and marsh) ecosystems to C-GOOS. However, the GSC has recommended that the panel broaden the scope of its mandate to include inland seas and the near-shore coastal environments. The Panel has been asked to complete a draft design plan for implementation within 18 months in order to mesh more closely with the schedule set by C-GOOS.

To detect patterns and trends of living marine resources, systematic measurements are needed of ecosystems and the processes that affect them. The LMR Panel identified the need to collect information on ecosystem components and ecosystem conditions. Ecosystem components include top predators, commercial fin-fish, forage and nekton, benthos, zooplankton, and phytoplankton. Here, information is needed on (i) abundance and distribution; (ii) reproduction, recruitment and growth; (iii) the ecosystem role, and (iv) causes of mortality. To monitor ecosystem conditions, data are needed on nutrients, temperature, salinity, dissolved oxygen, currents and atmospheric forcings (wind stress, heat exchange, evaporation-precipitation). The LMR report elaborates on how specific measurements might be made in developing an 'end-to-end' monitoring system and defines the kinds of products the Panel believes users are looking for. The C-GOOS panel is addressing these issues as part of its intersession work to design the global C-GOOS network and draft proposals for the design and implementation of pilot projects.

Initial LMR pilot projects will be retrospective analyses of data from well-sampled regions where significant ecosystem changes have been observed (e.g., regime shifts in the northeast Pacific) to evaluate (i) the predictability of such changes; (ii) the extent to which predictions could be improved with the measurement of additional variables. Inter-sessional pilot studies were proposed for the Baltic, California Current, Sea of Japan, northwest Atlantic, northeast Atlantic, and Benguela Current.

5.1.4 Joint Data and Information Management Panel (J-DIMP)

The achievement of a predictive understanding of environmental change in coastal ecosystems depends, among other things, on the development of regional to global networks that link observation, analysis and application in more effective and timely ways. The establishment of procedures for data and information management is the responsibility of J-DIMP. This must take into account the greater diversity of potential user groups in C-GOOS than in other GOOS modules. The data and information strategy being developed by J-DIMP aims to maximize the use of data and information on coastal habitats and natural resources by optimizing the flow of data and information from sensor to user and to increase the cost-effectiveness of environmental observations. These goals will be achieved by (i) developing more effective linkages between the providers of data on environmental change and user groups; (ii) minimizing data delays, losses and redundancy; (iii) improving metadata records; (iv) documenting quality assurance and control procedures; and (v) increasing access to data and information. J-DIMP and the GSC will draft the data policy for GOOS. In the absence of a stated policy, the data policy for GOOS is the data policy of the sponsoring organisations and is covered, for example, by WMO's regulation 40.

Once the strategy for data and information management for GOOS as a whole has been established, it will then be the responsibility of the C-GOOS panel to develop its own data and information management plan. A draft J-DIMP plan is expected to be available in time for data management to be addressed at C-GOOS-III. Given similarities in the data requirements of the C-GOOS, HOTO and LMR modules, the possibility of a joint effort should be explored at that time.

5.2 REGIONAL GOOS AND RELATED PROGRAMMES

5.2.1 Regional Seas Programme of UNEP (Summerhayes, Kasten)

The Regional Seas Programme (Annex X) was created in recognition of the need for intergovernmental collaboration on environmental problems in coastal water bodies that cross political boundaries. The Regional Seas Conventions and Action Plans provide a legal framework for environmental research and monitoring in many coastal regions. The programme does not include coastal waters that are covered by other Conventions, e.g., the Baltic Sea (Helsinki Commission, HELCOM) and the northeastern Atlantic (Oslo-Paris Commission, OSPARCOM). Information about the work of these Commissions is available on the Internet.

C-GOOS will collaborate with the Regional Seas programme to avoid duplication; to capitalize on existing intergovernmental agreements and infrastructure; to involve stakeholders; and to integrate these programmes into the global observing system for more effective data analysis and delivery of products and services. Initial areas of cooperation include the following:

(i) In east Asia, NOWPAP is involved in implementing a HOTO Pilot Project (sections 5.1.2; 5.2.3);
(ii) The Mediterranean Action Plan (MAP) office was involved in the establishment of MedGOOS; and
(iii) SPREP (South Pacific Regional Environment Programme) is implementing the Regional Seas programme for the Pacific islands and was involved in the establishment of PacificGOOS.

HOTO and C-GOOS share common interests in the Black Sea and the design and implementation of Black Sea projects should be done in collaboration with UNEP's Black Sea Environmental Programme.

5.2.2 MedGOOS and PacificGOOS

At the time of the C-GOOS-I, MedGOOS and PacificGOOS had just been formed and the timing was not right for discussions of how C-GOOS should partner with these regional programmes. A MedGOOS workshop is planned for Rabat in May/June 1999, to address the benefits and costs of implementing GOOS in the Mediterranean Sea. A representative of C-GOOS should be invited to this meeting. Likewise, C-GOOS should be represented at the PacificGOOS workshop planned for Noumea, in October 1999 to initiate planning for long-term monitoring and observing in the region's coastal seas.

5.2.3 NEAR-GOOS (Wang Hong)

NEAR-GOOS has made significant progress since its inception. Progress includes (i) an intergovernmental agreement to freely exchange data; (ii) an increase in the number of users; (iii) an increase in data suppliers and a doubling of data holdings; (iv) recognition of NEAR-GOOS by complementary programmes, such as NOWPAP; and (v) continuation of an extensive Japanese programme of R & D to underpin NEAR-GOOS. For the first time all four partner countries are submitting data to NEAR-GOOS. The next goals are to include biological and chemical variables in the data base and to develop the modelling component. Plans for collaborating with HOTO and NOWPAP are also in the works.

The discussion revealed that some local scientists either were unaware of the existence of the NEAR-GOOS data management programme or experienced difficulty accessing data. Wang Hong (who is a member of the NEAR-GOOS Coordinating Committee and provides an important link to C-GOOS) explained that the bureaucratic requirements for registration prior to access to the database will be simplified to attract more users. Additional efforts to publicize the activities of NEAR-GOOS could include (i) formation of National GOOS Coordinating Committees in each of the partner countries; (ii) producing and distributing the NEAR-GOOS brochure in the languages of member nations (in addition to English and Japanese); (iii) publication of articles in journals and the popular press and talks at meetings of scientists and other user groups; and (iv) organization of national and regional workshops on GOOS and NEAR-GOOS.

The C-GOOS panel will work with NEAR-GOOS to develop a joint pilot project, e.g., the proposed remote sensing project (see agenda item 7.2). C-GOOS should also explore opportunities to develop partnerships with HOTO, NOWPAP and NEAR-GOOS in the design and implementation of joint projects. .

5.2.4 EuroGOOS (Summerhayes)

The EuroGOOS Association continues to be very active, having grown to 30 partner agencies from 16 countries. Its goal is to improve inter-agency, inter-disciplinary, inter-country operational oceanography at the European level, following the Principles of GOOS, and in so doing to make a major contribution to GOOS. EuroGOOS has a dual focus: (i) on coastal seas, including the Mediterranean, the Baltic, and the Northwest Shelf (including the North Sea); and (ii) on oceanic areas, including the Atlantic and the Arctic.

This year EuroGOOS has been successful in attracting 15 million Ecus from the European Union (EU) to fund R & D in support of GOOS development, for example, for the Mediterranean Forecasting System. In part the success of the proposals for funding reflects the strong EU funding line for marine R & D, through the Marine Science and Technology programme (MAST). It is said that funding for marine science and technology will remain strong in the successor to MAST, the EU's Framework V programme.

EuroGOOS has published a Strategic Plan, an outline Implementation Plan, a Technology Plan, a Science Plan (draft copies of which were circulated to C-GOOS Panel members), and the proceedings of the first EuroGOOS Conference. These documents provide useful advice for the design of C-GOOS. In press are several Working Group reports and the full Implementation Plan. Work in progress includes a pan-European user survey, and a cost-benefit study, both of which will provide methodologies for undertaking these kinds of studies in other regions, and which are likely to prove useful in refining the C-GOOS design.

The Panel agreed that the background document, " The Science Base for EuroGOOS", is a useful generic statement of what needs doing before GOOS can be implemented comprehensively. It shows what scientific methods and understanding are already available and can be applied operationally to provide services and forecasts needed by government, commercial and scientific users, and it shows where present scientific knowledge is not sufficient to develop or improve routine services and where research is now needed. It will benefit C-GOOS to develop strong ties with EuroGOOS.

5.3 CORAL REEF PROGRAMMES (Ogden)

Coral bleaching is occurring globally. A report of the International Society for Reef Studies (ISRS) concludes that 1998 has seen the most geographically widespread episode of coral bleaching ever recorded. The bleaching has been exceptionally severe, with a large number of corals turning white and subsequently dying, probably mostly due to unusually warm sea surface temperatures. In addition there was brief mention of the report in the LOICZ Newsletter (No.8) for September 1998 that increased dissolution of CO_2 in the ocean appears to be reducing the calcifying ability of coral organisms, thereby possibly weakening modern reef structures.

The GCRMN was established as a programme of the International Coral Reef Initiative (ICRI) by the IOC, UNEP, World Bank and IUCN [International Union for the Conservation of Nature (and Natural Resources)]. As described in the GCRMN strategic plan, this programme, which at present is coordinated from Townsville, Australia, is designed to work through a series of regional nodes, only a few of which are well developed at this time. The South Asian node, based in Sri Lanka, is particularly successful, largely due to the funding of a full time coordinator by the UK's Department for International Development (DFID). There will be a major GCRMN meeting in Australia in November 1998 to evaluate progress and to stimulate the development of other regional nodes.

The GCRMN is already accepted as part of the GOOS Initial Observing System, and in effect is one of the responsibilities of C-GOOS. The current focus is on biological monitoring and there is a need for measurements to better define the physical setting. C-GOOS should promote this and continued evaluation of the monitoring programme, especially as related to the identification of indices of the health of reef ecosystems.

5.4 LAND-OCEAN INTERACTIONS IN THE COASTAL ZONE PROGRAMME (Pacyna)

Preliminary work on developing a working relationship with LOICZ has begun (Annex XI). Unlike C-GOOS, LOICZ is a funded research programme with a limited lifetime. Its purpose is to conduct the reseach required to understand how inputs from terrestrial, atmospheric and oceanic sources affect coastal waters and, in this context, determine the effects of human activities on inputs and the health of coastal ecosystems. LOICZ provides the scientific basis for many of the operational objectives of C-GOOS in much the same way that GLOBEC provides the scientific basis for the objectives of the LMR module.

To achieve its goals, LOICZ has established research programmes in coastal ecosystems that differ in terms of external forcings (e.g., nutrient and contaminant loads from land and air, oceanic effects) and scale (size, shape, ecological complexity). The coastal typology under development by LOICZ may be useful as the design for C-GOOS is planned. The data bases generated by these programmes must be captured by the C-GOOS data management process, and many of the measurements made (e.g., waves, currents, tides, temperature, salinity, nutrient concentratons, dissovled gases, productivity, concentration of contaminants) and models developed (e.g., numerical models of circulation and ecosystem structure and function) will be incorporated into the design of C-GOOS. The results of LOICZ research programmes will also be instrumental in helping to define the time-space scales of the C-GOOS measurement programme and in the validation of numerical models and algorithms.

There is a clear and immediate need to collaborate in developing the linkages for effective information exchange, and the development of joint projects.

5.5 GLOBAL ECOLOGY AND OCEANOGRAPHY OF HARMFUL ALGAL BLOOMS (GEOHAB)

5.5.1 The Harmful Algal Bloom (HAB) Programme of the IOC (Zingone)

HABs are important elements of coastal seas because they affect human health, marine resources, tourism and recreation, and ecosystem health. The objective of the IOC-HAB Programme is to foster research and education on harmful algal blooms in order to understand their causes, predict their occurrence and mitigate their effects. The programme has three foci: educational, scientific, and operational. An Intergovernmental Panel (IPHAB) helps to ensure governmental support for the programme, and to assign priorities. Almost 30 countries participated in the last Panel meeting in 1997. Task Teams have been appointed within the Panel on specific aspects of HABs, including: (I) Aquatic Biotoxins; (ii) Algal Axonomy, and (iii) Monitoring and Management. The education programme includes an information network to communicate with scientists, administrators and the public, and a comprehensive training programme on taxonomy, toxin chemistry and monitoring. Publications include a Manual on Harmful Marine Microalgae; the Harmful Algal News; and various other manuals and guides. An International Conference has been organized with the Asian Pacific Economic Community (APEC) on Harmful Algae Monitoring and Management (HAMM, 10-14 May 1999, Subic Bay, the Philippines). Basic knowledge on the ecology and oceanography of HABs is insufficient, and research is an important part of the programme. To this end, working groups have been established by ICES-IOC (dynamics of HABs) and SCOR-IOC (physiological ecology of HABs). At its Fourth Session in 1997, the IPHAB decided to work towards the development of a science agenda on the ecology and oceanography of HABs. IOC invited SCOR to take joint action in this process, which has recently led to the establishment of an international science programme, GEOHAB (see 5.5.2). Information on the HAB programme is available on line through http://www.unesco.org/ioc.

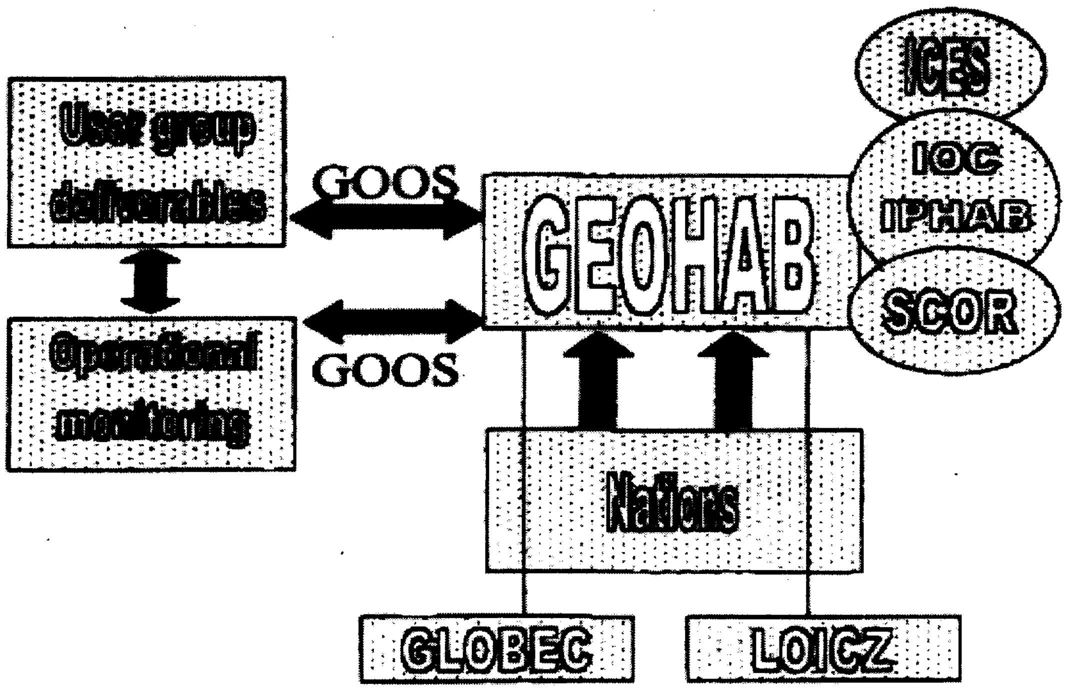

Figure I. illustrates the relationship between GEOHAB and its two mother organizations SCOR and the IOC.

5.5.2 GEOHAB (Zingone and Malone)

The proposal to establish GEOHAB (Global Ecology and Oceanography of Harmful Algal Blooms) as a new scientific programme was developed at a SCOR-IOC workshop in October, 1998. The mission of GEOHAB is to foster international cooperative research on harmful algal blooms in an ecosystem context. The scientific goal of the programme is to determine ecological and oceanographic mechanisms underlying the population dynamics of harmful algae. GEOHAB, explicitly incorporates C-GOOS in the planning process upfront (Figure I). The knowledge and tools generated by GEOHAB will benefit C-GOOS in the form of more effective operational monitoring systems, data-based risk assessment, and improved forecasts of the timing, magnitude and effects of HABs. In turn, it is expected that GOOS will encourage the implementation and development of sustained observing systems required to document trends, evaluate the efficacy of management actions (mitigation), and define those areas that require additional research. C-GOOS will promote the use of the new knowledge and technological advances generated by research programmes for applied purposes and provide the framework of observations required to understand the global significance of results from research on targeted ecosystems. A global, long-term monitoring network in representative coastal regions will constitute a significant step forward in the attempt to understand the causes and consequences of HABs.

5.6 CAPACITY BUILDING IN C-GOOS (Marone)

An early draft of "Principles of GOOS Capacity Building" was endorsed by the Panel and is given in Annex XII. The purpose of capacity building is to make possible the continued involvement of developing nations in GOOS. Capacity building includes education and training; the building of appropriate institutional support structures; the creation of networks; infrastructure elements (e.g., platforms, sensors, and data centres); and providing access to communication networks for data telemetry and dissemination (e.g., the Internet, downloading and visualizing satellite data). Capacity building will be an integral component of C-GOOS activities including the design of pilot projects.

There are many capacity building programmes that C-GOOS can work with in achieving the goals of capacity building. These include TEMA (IOC); START (IGBP);Train-Sea-Coast (UN); and the training activities of GLOSS, the IOC-HAB programme, and NEAR-GOOS; the IOC-EU South American oceanographic network; and the International Centre for Theoretical Physics. Users who may be prepared to be partners in capacity building include government agencies responsible for the management of the environment and natural resources, universities, conservation groups (NGOs), navy meteorology and oceanography departments, industry, and harbour authorities. The creation of national GOOS Coordinating Committees will help stimulate this process.

Universities may make significant contributions to achieving the goals of capacity building. There are a great many general training and education programmes in universities, technical colleges, fisheries institutes, and merchant and military naval colleges that C-GOOS could enlist. As a first step, these institutions could be enlisted to use GOOS information and materials in their courses. C-GOOS could also develop courses and training programs of its own. The Web should be used more effectively to disseminate information on C-GOOS activities, and information that is useful to user groups.

Within GOOS, capacity building has been directed by an *ad hoc* Panel. This will be replaced with a standing committee of the GSC. The new Capacity Building Panel will coordinate closely with all the GOOS Panels and the IOC's Training, Education and Mutual Awareness (TEMA) programme. The new Panel will include a member from each of the 4 GOOS scientific design modules. The representative from C-GOOS will be Eduardo Marone.

6. IMPLEMENTING THE GOOS END-TO-END APPROACH

6.1 THE C-GOOS DESIGN PROCESS (Thompson)

The ultimate goal of C-GOOS is to provide the basis, in observations and models, for assessing the effects of human activities and for predicting change in coastal waters. At its first meeting, the C-GOOS panel developed a procedure for the design of end-to-end observing systems that link bottom-up (measurement programmes) and top down (user needs) perspectives. Critical links between these "end members" include precise definition of the attributes to be predicted or described, determination of acceptable time lags between observation and the delivery of products, identification of models that are to be used to link measurements to products, and the definition of model inputs and outputs. The process begins with the identification of operational categories (preserving and restoring healthy ecosystems, sustaining living marine resources, mitigating natural hazards and safe and efficient marine operations) and related environmental issues (Table I). Subsequent steps are as follows:

(i) Final Prediction:
Define the final form(s) of the prediction. It is recognized, for example, the coastal managers do not need predictions about the possible occurrence of a red tide in the form of a complex model output. A straight forward alert may suffice. On the other hand, a coastal engineer designing flood defenses may need a precise confidence interval for the probability that a critical level will be exceeded. The term prediction is not used simply in the sense of forecasting the future, but also in the sense of estimating by interpolation a quantity which is not observed directly; it may include, for example, inferring the present biodiversity of an ecosystem from measurements made at a small number of observing stations. It also includes the spatial extrapolation of return times of extreme sea-levels from a tide gauge with a long record to a coastal site with little or no sea-level data. Examples of predictions include: frequencies of flooding and extreme waves and currents; optimal shipping routes; extent of potential loss of habitat; probable effects of oxygen depletion in bottom water.

(ii) Lead Time:
This is the acceptable time lag between measurement and prediction. For cases involving straightforward spatial interpretation this may be zero (e.g., the probability of a specified sea-level being exceeded at a site without a tide gauge). On the other hand, useful storm surge forecasts are required hours to days ahead while land use management decisions might be based on GIS products that require days-months to produce.

(iii) Identification of the Types of Models to be used:
This may range from conceptual models, GIS, and simple regression models (based on empirical relationships) to sophisticated, coupled ocean-atmosphere and hydrodynamic-ecosystem models based on theory and empirically derived parameters.

(iv) Model Variables (Outputs):
This describes the quantity predicted directly by the model. It might be, for example, time-varying fields of currents or productivity, linear trends of sea level over recent decades, or ice distribution. In many

instances this will differ from the final form of the prediction provided to users which will commonly be a highly reduced version of the raw model output.

(v) Model Inputs:
The are the observations needed to make the predictions. Many are common to several issues, e.g., winds, air pressure, sea-levels and currents, sea surface temperature and salinity, and concentrations of nutrients, chlorophyll-a, oxygen, and suspended particulate matter.

(vi) Feasibility:
The feasibility (cost and the availability of acceptable technologies and techniques) of the approach or method is ranked high, medium or low.

(vii) Cost-Benefit Analysis:
This is the ratio between the cost of the measurement programme and the benefit of making the prediction. This is arguable the most difficult step, but a relative ranking of high, medium or low may suffice in the first instance. When completed, this final column should be used to order the measurements (model inputs) in terms of the cost of measurement vs the impact of the input data on the model output. The step is explored in greater depth in section 6.2.

Table I. Globally ubiquitous indicators of environmental change in, and human uses of, coastal waters. This is a modification of Table I in the report of C-GOOS-I. It has been modified to distinguish between causes and consequences. Indicators of change are the consequences of either natural or anthropogenic sources of variability, or both.

OPERATIONAL CATEGORY	INDICATORS OF CHANGE
Preserve & Restore Healthy Ecosystems/Manage Resources for Sustainable Use	declining living marine resources
	oxygen depletion (hypoxia, anoxia)
	increased in phytoplankton biomass
	harmful algal blooms
	fish kills
	habitat loss (e.g., wetlands, sea grasses, coral reefs)
	diseases in marine organisms
	growth of nonindigenous species
	loss of biodiversity
	temperature & salinity distributions
Mitigate Coastal Hazards	loss of property and human life
	lack of economic stability
	higher insurance rates
	sea-level rise
	coastal erosion
Safe & Efficient Marine Operations	loss of property and human life
	spills of hazardous materials (oil, chemicals, radio-isotopes)
	introduction of nonindigenous species (ballast water)

A working group was charged at C-GOOS-I to perform this analysis for all of the issues (indicators of change in the new table) listed in Table I. This proved to be a difficult task, in part because measurements of input variables differ in the extent to which they are operational (measured routinely in a timely fashion with known precision and accuracy), i.e., observing systems for climate that require inputs of physical variables (e.g., wind, temperature, salinity, currents, sea surface height) are operational or close to being operational. This cannot be said for observing systems for ecosystem health or the management of living resources in that many biological and chemical variables cannot be measured at this time in an operational sense. Thus, the working group found that separate analyses were needed for those issues that relied solely on physical quantities and for those that relied on multidisciplinary inputs.

In addition to differences in operational status, this reflects the reality that physical variables such as sea-level, currents and water temperature are not affected strongly by biological variables while biological and chemical variables interact strongly and are affected by the physical environment.

Clearly, more work will be required for this approach to become fully functional as a guide to the design and implementation of C-GOOS. Nevertheless, the Panel feels that the approach is a powerful tool for designing end-to-end observation systems.

The Panel noted that some biological and chemical measurements are operational, for example ocean colour data are routinely produced and used as guides by the fishing industry, and fish statistics are collected regularly. Nevertheless, the Panel agreed that the lack of knowledge of how perturbations are propagated through coastal ecosystems to cause changes such as those listed in Table I is limiting to the design of fully operational observing systems at this time. Recognizing the requirement for additional ecosystem level research, the Panel concluded that, in some cases, the immediate purpose of observing systems will be to document the spectra of variability that characterize coastal systems, i.e., to quantify the temporal and spatial dimensions of patterns of variability that are relevant to indicators of change (Table I). In this regard, the Panel further recognizes the importance of research programmes (e.g., LOICZ and GEOHAB) as the means by which ecosystem models will be developed that will satisfy the requirement for models that link the measurement of properties to outputs that have applied uses.

In terms of measurement programmes, the panel will place high priority on identifying those properties and process that must be measured to document and predict indicators of environmental change (Table I). This includes specifying the time and space scales on which measurements should be made, the precision and accuracy required, and assessment of the need for and impact of new technologies (e.g., HF radar for surface currents; remote sensing for salinity).

6.2 COST-BENEFIT ANALYSIS OF MEASUREMENTS (Hall)

An important step in the design process described above is the cost-benefit analysis of measurements. The approach taken by the HOTO Panel (IOC, 1996) was adopted for this purpose, prioritize properties to be measured in terms of their impact (e.g., importance to decision making or as an input variable to a numerical model) and the feasibility (cost, difficulty) of making routine measurements. In an x-y plot of impact versus feasibility, properties fall into one of three categories:

(i) the property is easily measured (routine) and has a high impact;
(ii) the property has a low impact and is difficult to measure (not routine or the technology does not exist); and
(iii) the property has a high impact and is difficult to measure.

Properties that fall into category (iii) should be the subject of active research and development efforts to move them to category (i).

Three impact versus difficulty diagrams were presented for discussion, one each for physical, chemical and biological properties. Three sources of information were used to assign the level of impact: (i) Tables 2, 3, and 4 from the Miami Coastal GOOS Workshop report, which presented a set of variables considered in terms of the use to particular user sectors (impact defined as how many times a particular variable was mentioned as desirable); (ii) The results of a preliminary issue-specific design analysis conducted during intersession and presented for discussion under 6.1; and (iii) Information from the paper by Costanza et al. (Nature, 387, 253-260,1997), which provides more information on the potential impact of particular variables.

Feasibility of measurement was based on the research experience of the working group and was assessed as follows: (i) low - easily measured with basic knowledge and equipment; (ii) medium - moderate levels of expertise and equipment required; and high - expert knowledge and high-tech equipment required.

Considerable debate followed concerning the impact-feasibility ranking of each property that involved the following issues: directly measured vs a derived estimate (e.g., ocean color vs chlorophyll concentration) and the current lack of understanding of the structure and function of ecosystems often makes it difficult to assign a meaningful level of impact (need more rigorous analyses such as sensitivity analysis of ecosystem models). The suggestion was made that, given the current state of knowledge, as many properties and processes as possible should be measured. This was countered by the fiscal reality of "measuring everything" and the argument that the minimum number of core variables (that are relevant to many indicators of change and satisfy multiple user needs) must be identified that will define the basic skeleton of an integrated observing system and provide the means of comparing different systems, interpolating among systems, and extrapolating to systems that are beyond the range of observation. Additional variables can then be added on a case by case basis depending on the issues being addressed.

6.3 INTEGRATING REMOTE AND *IN SITU* MEASUREMENTS (Kiefer)

A critical feature of coastal ocean observing systems is their ability to quantify the time-space dimensions of pattern. This is especially challenging given the broad spectrum of variability that characterizes coastal waters. Geographic information systems (GIS) are data analysis tools that reference diverse kinds of data to their position in space. Spatial referencing systems that can move with the water will be important tools for transforming observations in time and space into useful visualizations of time dependent changes in property fields. The Environmental Assessment SYstem (EASY) is one such system. This software integrates data collected on different time (e.g., *in situ* measurements) and space (e.g., remote sensing) scales to show how property distributions (e.g., chlorophyll, the plume of an effluent, an oil spill) change through time. It also has the capability of running numerical models within the context of the spatial data sets, a feature that has proven useful for both fisheries management and pollution risk analysis.

To illustrate the power of integrating synoptic spatial observations with high resolution time series measurements, a GIS software package was demonstrated. Test applications were shown for the southern California Bight (development and movement of effluent plumes following storms) and the northern Adriatic (Po river outflow and coastal eutrophication). The system works in a PC Windows environment and can run on a PC or on the Internet. It is modular, with discrete files for each project; it can provide 4-dimensional representation so that the evolution of pollutant plumes and other phenomena can be visualised over a specified time period. In California, the users are the general public, who are concerned about the levels of pollution on beaches. The data comprise: storm drain data; offshore current meter data; Synthetic Aperture Radar (SAR) satellite images of surface roughness (a good indicator of plumes, even when clouds are present); and plume models.

7. **ELEMENTS**

7.1 A GLOBAL COASTAL NETWORK (Thompson)

During the course of the meeting it became apparent that an effective design strategy for C-GOOS would be the parallel development of regional and global scale components. The global C-GOOS network would be based on a minimal set of core measurements much as described in section 6.2, a concept that is also consistent with the approach used by the OOPC. This will not only provide a global framework for national and regional scale GOOS programmes, it will provide the global scale perspective of environmental changes in coastal waters required to distinguish between local changes that are related to local effects and local changes that are related to regional and global effects.

Initial discussion focussed on the following elements:

(i) a "GLOSS-plus" array, because sea-level is a great integrator;
(ii) an array of meteorological buoys enhanced with *in situ* oceanographic sensors to improve marine meteorological forecasts and coastal circulation models;
(iii) a linkage to the open ocean observing system to supply boundary conditions for coastal models;
(iv) measuring flows through critical straits, for instance from instrumented ferries; and
(v) satellite imagery (e.g., RADARSAT, SeaWiFS, AVHRR).

Vincent et al. (1993) provide a starting point for planning the sampling design for *in situ* measurements. Selection of station locations and environmental variables to be measured will be determined through an objective assessment and numerical analyses that will consider the distribution of people in the coastal zone, the susceptibility of coastal environments to natural hazards, and sampling requirements for (i) improving weather forecasts, predictions of natural hazards, and climatology; and (ii) a sufficient number of cross-shelf transects ("corridors") to capture changes in coastal waters caused by point and nonpoint discharges from coastal watersheds, fishing, and larger scale oceanic and climate variability. Corridors will be located where measurements will reveal the health and regional trends of the coastal ocean, i.e., sites that are influenced by riverine discharge which integrate the effects of human activities in coastal watersheds, support major fisheries, or are sensitive to larger scale oceanic and climatic variability.

In regard to satellite imagery, problems related to the mismatch between the time scales of coastal processes (hourly, semi-diurnal, daily) and the long orbital repeat time of satellites can be serious problem in terms of the ability to capture time-dependent changes in property fields. This problem will be at least partially solved through the use of geostationary satellites. This potential significance of this capability to C-GOOS will be communicated by the GSO to the space agencies via GOSSP (Global Observing Systems Space Panel).

7.2 POTENTIAL PILOT PROJECTS

Each of the pilot projects described below are preliminary. They were presented for discussion at the panel meeting and will be fully developed (using the format given in section 8.1) during the intersessional period for presentation at C-GOOS-III where priority projects will be identified for inclusion in the design strategy for C-GOOS.

7.2.1 Eastern South Pacific (Ulloa)

The intra-annual behaviour of the coastal seas on the western seaboard of South America is dominated by remote forcing from the equatorial Pacific (including but not limited to ENSO events). As a result, local conditions cannot be predicted based on local measurements alone. With better data it should be possible to develop accurate 2-month forecasts of changes in, for example, coastal currents.

The project requires the following elements:

(i) data from the TAO moorings in the equatorial Pacific;
(ii) four meteorological/oceanographic (Met-ocean) buoys along the coast;
(iii) seven digitally recording tide gauges with GPS;
(iv) remote-sensing by ENVISAT (which is not working right now);
(v) 3-D, time-dependent circulation model;
(vi) topography.

If successful, the project will lead to hourly predictions of currents on the shelf and in bays and harbours. It should be of interest to a wide range of users, including environment agencies, harbour authorities, coastal managers, and industry. It would serve two main C-GOOS operational categories: preserving healthy coasts and safe and efficient marine operations. It would address several C-GOOS issues, among others: toxic contamination, nutrient over-enrichment, and spills of hazardous materials. Given the importance of climate and air-sea interactions, this is a candidate for a joint project with the OOPC.

The technology is essentially available, given appropriate funding. The problem in initiating the project is the politics: how do we get Colombia, Ecuador, Peru and Chile to collaborate? And who will decide which scientists get together to do the work? Clearly the users have to be involved as early as possible, and there is already a lot of local interest, tempered with apprehension about the main political angles, which include: (i) setting up a joint project (finding the people and the resources to implement the system, maintain it, do the modelling and produce and disseminate the output), and (ii) sharing the data.

In discussion, the Panel agreed that overcoming political obstacles was one of the useful roles for the sponsoring organisations and recommended that this question be taken through the GSC, to I-GOOS-IV and thence to the IOC Assembly. Similarly the question could be addressed by UNEP, through its Regional Seas programme, and by the WMO. It should be noted that for more than 12 years, WMO and IOC have been trying to get approval for a sizeable project to establish an observational network along the margin of the southeastern Pacific. Fernando Guzman, of the Ocean Affairs Division of the WWW, has been working on the design of a Humboldt Current project, which could cover C-GOOS interests along with others. A joint IOC-WMO workshop on the topic of observing the southeastern margin of the Pacific might prove a useful platform for promoting the C-GOOS pilot project. It would also be useful to create a network of the marine laboratories that have an interest in taking such a project forward. It was agreed that the GPO should work to exploit the intergovernmental machinery to encourage Member States to co-operate.

7.2.2 Remote Sensing: Algorithm Development For Coastal Waters (Sinjae Yoo)

The goal of this proposed project is to develop a global network of laboratories that supply the *in situ* data needed to parameterise optical properties of coastal waters as the basis for developing regional algorithms for use in reflectance models applied to remotely sensed ocean colour data. The project will facilitate eventual operational use of remotely sensed ocean colour data in coastal seas.

The key problem in the interpretation of remotely sensed images of ocean colour is to differentiate between what is caused by phytoplankton and what is caused by suspended sediments and dissolved organic matter. Surface waters are typically divided into two categories: (i) case 1 waters, where phytoplankton is the major independent variable controlling colour, and where there is a useful algorithm for determining chlorophyll, hence phytoplankton, from colour; and (ii) case 2 waters, where there are several sources of the colour and the development and validation of algorithms is more difficult.

Through the use of an appropriately parametrised reflectance model, it should be possible to extract information on the concentrations of (i) coloured dissolved organic matter; (ii) chlorophyll; (iii) total suspended matter; and (iv) suspended solids. However, the optical properties of these materials vary from location to location, and site-specific algorithms must be developed to account for the unique optical characteristics of the materials found in each region. Hence the need for *in situ* measurements of optical spectra. The spectral measurements needed for the construction of appropriate algorithms include profiles of (i) downwelling and (ii) upwelling radiance spectra; (iii) the absorption of particles collected on filters; (iv) absorption by pigments; (v) absorption by the dissolved organic matter; and (vi) backscattering by particles.

The first step is to establish standard protocols for these measurements. The laboratories participating in the project will work together to derive, test and document an appropriate set of protocols, preferably ones that can be implemented simply and cheaply in many parts of the world. In the process, workshops will be needed to bring people together to compare the results of different studies. Once protocols have been established, scientists and technicians will have to be trained in making and applying the measurements.

It is proposed to initiate the development of the network, and to demonstrate the usefulness of *in situ* data for constructing site specific algorithms for coastal regions, by focussing initially on two regions: (i) the Yellow and East China Sea, and (ii) Chesapeake Bay. Once the approach has been developed and tested it can be applied not only to processing new ocean colour data from satellites, but also to the re-interpretation of the archives of data from the Coastal Zone Colour Scanner system (CZCS) and the ADEOS satellite.

In discussion it became apparent that algorithm development for Case 2 coastal waters is currently an important research focus of several laboratories and a solution seems likely within the next 2 years. Some panel members questioned the wisdom of promoting this work when it was already the subject of active research in several places. Others noted that the greatest wealth of coastal data was likely to come from satellite remote sensing, and that C-GOOS should assist in promoting it if that meant speedier establishment of a coastal observing system.

7.2.3 Harmful Algal Blooms (Zingone)

<u>Indo-Pacific Pilot Project</u>

To help to protect human health and food resources, research into the causes of HABs is now underway, as are some monitoring programmes for detecting harmful species or toxic seafood. Most of the monitoring programmes do not include observations of the environmental parameters associated with HABs, and most of the research focuses on specific biological aspects or on technology (e.g., detection capability). However, monitoring efforts are fragmented (lack continuity in space or time) and, with the important exception of recent research programmes (e.g., EcoHAB in the U.S. and the proposed GEOHAB programme of IGBP), few are multidisciplinary. Consequently, prediction of HABs and their effects is not possible at this time.

To enable successful prediction of the timing, magnitude and location of HABs, there is an urgent need to collect data about the key environmental variables associated with HABs, and to collect data over long periods to detect recurrent patterns and trends. In addition, comparative monitoring of different systems with full and free exchange of data among laboratories will improve knowledge, understanding and prediction of HABs.

A network of monitoring systems for *Pyrodinium bahamense* blooms in the Indo-Pacific region (Philippines to Indonesia) is proposed. This dinoflagellate species causes Paralytic Shellfish Poisoning (PSP) and is the dominant HAB species in the region. For example, serious outbreaks of PSP associated with this species have occurred in Manila Bay causing well over 100 deaths in the past 15 years and economic losses that reached $300,000/day for two months in 1988. The pilot project will address the following the questions:

(i) is there a recurrent pattern of phytoplankton succession in those locations where *P. bahamense* booms frequently?
(ii) under what environmental conditions does this species bloom and become toxic and what are the controlling environmental factors?
(iii) what is the role of resting cysts in the dynamics of the blooms?
(iv) is the spreading of these blooms related to weather or climate patterns?
(v) what causes the blooms to decline?

It is proposed that measurements be made in Manila Bay and Samar Bay in the Philippines, in Jakarta Bay, in Sabah, and in Brunei Darussalam, where blooms of *P.bahamense* have been recorded often and where there has been periodic sampling by local laboratories. Other sites meriting consideration are Kao Bay (North Moluccas), Papua New Guinea, and Hong Kong Bay. Data required include (i) species composition of phytoplankton communities; (ii) tides, currents and meteorological conditions; (iii) *in situ* cyst production and germination and the history of cyst deposition; (iv) water temperature and salinity; and (v) the concentrations of phytoplankton pigments, dissolved inorganic nutrients, dissolved organic nutrients, humic acid, and dissolved oxygen. Consideration will have to be given to the development of appropriate forecasting models, calling for instance on the state-of-the-art coupled circulation-ecosystem models being developed for plankton studies in other areas (eg the North Sea) or on Artificial Neural Networks.

PhytoNet

There is a growing concern that HABs may be increasing in frequency and occurrence worldwide. These apparent increases have been attributed by some to human activities related to nutrient enrichment of coastal waters and shipping which may spread seed populations through the transport and discharge of ballast water. The increases are labelled 'apparent' because coastal waters have been undersampled in both time and space and perceived increases may reflect increasing in sampling intensity. There is no doubt that HABs are a serious constraint to the increasing efforts of man to exploit the marine environment.

To meet the C-GOOS challenges of preserving healthy coasts and mitigating natural disasters, the frequency, magnitude and spatial distribution of HABs must be quantified on a global scale. The first step C-GOOS is to encourage the design and effective exploitation of HAB databases and to develop a network of laboratories for the timely dissemination of data on the occurrence of HABs and their effects, PhytoNet. The network should begin at the regional scale involving laboratories with sufficient data and resources required for a high probability of success, e.g., Europe. The main goals would be to insure that the data base on HABs is complete and kept current through the systematic document of the distributions of HAB species in the context of the species compostion of the plankton community in general and to evaluate changes in species composition in terms of their effects on the trophic dynamics of coastal ecosystems.

This will require (i) locating appropriate laboratories, monitoring agencies and databases; (ii) establishing a network between them; (iii) organizing the available data into structured, user-friendly databases (perhaps through an International Data Centre); (iv) establishing an information structure, with links to agencies concerned with human health, fisheries and coastal management; and (v) establishing linkages with scientific programmes (local, regional, and global).

7.2.4 Natural Disasters (Walker)

Forecasting storm surges in the northern Indian Ocean is the focus of this project. In this area, especially on the highly populated low lying coast of Bangladesh, storm surges lead to severe loss of life, killing up to 200-300,000 people during a single event. Storm surge modelling is well developed around the coasts of Europe, where massive investments have been made in coastal protection (e.g. the Thames Barrier in London, the activity of which is controlled in response to storm surge modelling). There is a need for comparable development of advanced predictive models for the northern Indian Ocean region. This will require major enhancements of the existing Indian Ocean network of monitoring sites.

This need has been recognized by the WMO and the IOC, and the IOC Executive Council at its November 1998 meeting will consider a proposal entitled "Project Proposal on Storm Surges for the Northern Part of the Indian Ocean", written by a Group of Experts convened by the IOC, WMO and UNESCO's International Hydrological Programme (IHP). The proposal has already been discussed and approved by the Intergovernmental Council of the IHP and by the WMO Executive Council. The proposal is extensive and comprehensive. It covers the same territory addressed by the C-GOOS work group, but is very expensive with a the total budget of $30 million.

Observing and modelling storms and associated surges requires an observing system that has the capability of (i) tracking the size and intensity of storms in real time; (ii) providing data on sea-level, waves and currents in real time; and (iii) forecasting the areal extent and depth of flooding based on topography, land type and cover, and runoff patterns. In light of these requirements, the Panel expressed some concerns about the IOC-WMO-IHP proposal, as follows:

> **Recognizing** that the establishment of a regional storm surge forecasting system is important for the preservation of life and property in the northern Indian Ocean;
>
> **Noting** with interest the development by the IOC, WMO and the IHP of a storm surge proposal for the northern Indian ocean;
>
> **Finding** that this proposal is wholly consistent with the overall aims of the draft proposal presented to the Coastal Module Panel of GOOS for such a system;
>
> **Notes** with concern that the IOC-WMO-IHP proposal seems to lack an inundation model for flooding prediction; and
>
> **Asks** how the IOC-WMO-IHP proposal meshes with the interests of the national agencies in the region.
>
> **Asks further** how capacity will be built in the region by the implementation of this proposal, given that the proposal seems to indicate that the work will be done by consultants; and
>
> **Asks further** whether the equipment used will be left behind at the conclusion of the project, and whether the local population will have been trained by the project operators to operate and maintain the equipment and interpret the results in terms of forecasts.

The Panel recommends that the concerns raised be addressed by the proposers and the C-GOOS experts together and confirms that if these concerns are addressed in a satisfactory manner, the proposed IOC-WMO-IHP project could be adopted as a pilot project of the Coastal Module of GOOS.

7.2.5 Networking Metadata (Walker)

A vital aspect of C-GOOS services for users is the ability to readily access the wide range of data required to support analysis, decision making and predictive systems. Data gathering activities are widely dispersed in space, time and application area. In addition, the coastal zone is affected by inputs from land, sea, and air. Thus, any application in the coastal zone is likely to need data from a wide range of sources. Some applications will require real-time or near real-time inputs.

Several coordinated international efforts already exist for storing and disseminating environmental data. Examples of current international efforts include (i) World Weather Watch (WWW), (ii) Permanent Service for Mean Sea-Level (PSMSL), (iii) Global Sea-Level Observing System (GLOSS), (iv) World Ocean Circulation Experiment (WOCE) Data Centres, and (v) National Oceanographic Data Centres (NODCs) of IODE. These and other such systems are potentially valuable resources that should be considered in the design of C-GOOS. However, except for meteorology, many existing data networks are not designed for near real-time data access and some are highly specialised covering a narrow rage of disciplines or applications.

At present data management activities are often confined to the development of meta-databases, of which there are many quite comprehensive ones. The design and implementation plans for C-GOOS must address the following: (i) establishing standard formulas for data archives of 'standard' variables, (ii) developing common interfaces for sharing data between institutions, agencies and nations, (iii) demonstrating the ability to update data bases on line in a timely fashion (preferably automatically), (iv) demonstrating the ability to rapidly assimilate and analyze data on line, and (v) addressing issues of ownership and access to data especially as data become valuable. Much has been accomplished in these areas, and C-GOOS will need to build this and to adapt existing systems to particular needs in the coastal zone. This challenge will be considered under the heading of data and information management at C-GOOS-III.

7.2.6 HOTO Projects (Knapp)

The Black Sea

The HOTO Panel considers the Black Sea a high priority for GOOS due to the severity of its environmental problems. Anthropogenic forcings are extensive (inputs of oil, nutrients, pesticides and synthetic organic chemicals); the Sea is highly eutrophic; HABs are common; the food-web has been severely altered; and fisheries have declined to the point where only 6 out of 26 formerly commercially valuable species remain economically viable.

The many programmes that have been created to help understand the processes underlying the problems include (i) the Black Sea Environmental Programme, established in 1993, led to the Black Sea Strategic Action Plan; (ii) the Danube Delta project; (iii) the Co-operative Marine Science Programme for the Black Sea (CoMSBlack); (iv) the NATO TU Black Sea Project; (vi) the EROS-2000 Programme of the EU, (vii) the Black Sea regional programme established in 1995 by the IOC; and the coordinated tracer programme of the IAEA.

The proposed HOTO pilot project has two main areas for monitoring: (i) biogeochemical-ecosystem measurements for ecosystem processes, biodiversity, habitat loss, endangered and threatened species, and changes in community structure; and (ii) human health-related problems created by consumption of contaminated seafood or direct contact with contaminants ranging from the HOTO variables of organics and metals to naturally occurring toxins and pathogens derived from sewage and natural processes. Properties to be measured were prioritized as follows:

High - algal toxins, herbicides/pesticides, phytoplankton pigments and community structure, nutrients, dissolved oxygen and petroleum compounds;

Medium - artificial radionuclides, litter and plastics, synthetic organics, poly-aromatic hydrocarbons, trace metals, and suspended organics;

Low - pharmaceuticals and human pathogens.

Since the HOTO meeting (October 1997) more data have emerged. First are the results of a set of workshops designed to investigate the feasibility of starting a Mussel Watch programme in the area. As well as investigating the body burden of contaminants in the mussel, it has been suggested that biological health measurements be made on mussels as proxy measures of ecosystem health. The use of biomarkers as proxy indicators of ecosystem health has been proposed by HOTO and GIPME. They would be relatively easy to measure in mussels in a region like this, and would provide useful information where chemical data are lacking. HOTO would like to start a training programme for these parameters in the Black Sea as part of a HOTO Pilot Project that could later be expanded to other regions.

Finally, a meeting of observational scientists and modellers (October 1998) concluded that:

(i) Major efforts are needed to understand and predict the pathways, regulation, feedbacks and roles of physical, climatic and anthropogenic factors in driving population dynamics and variability in Black Sea ecosystems;

(ii) the tools required are inter-disciplinary models, continuous observations, and process studies, performed with sufficient detail to take account of the existing physical, biogeochemical interactions in the strongly coupled oxic, suboxic and anoxic layers of the basin;

(iii) an operational data management system is needed to assist the observation and modelling efforts;

(iv) stations should regularly (e.g., at 2 week intervals) sampled along transects from the coast into the basin using small vessels off Bosphorus, Sinop, Batumi, Glenjik, Odessa, Consantza and Varna;

(v) core measurements would be like those of the JGOFS time series station off Bermuda, including nutrients, oxygen, hydrogen sulphide, phytoplankton biomass, zooplankton biomass, chlorophyll-a, salinity and temperature, supplemented by selected variables including some biological effects and contaminants so as to further the work on the use of biological health indicators;

(vi) a resolution should be drafted at the next meeting of the IOC Black Sea regional Committee (November 1998) to the launch a Black Sea GOOS programme in 1999. This would include the signing of a Memorandum of Understanding accepting the time series approach as a pilot project of Black Sea GOOS.

The HOTO pilot project should become an integral part of this effort.

Western Caribbean

For the past 8 years GIPME has been trying to obtain funding for a project to measure contaminant residue levels along with biological effects in tropical areas. Their focus is on the Atlantic coast of central America where the production of large quantities of bananas has led to excessive use of fungicides and pesticides to protect the crops. Because these phosphate-based compounds are non-persistent and degrade rapidly they are applied continually and enter the coastal system directly. GIPME now plans to conduct a workshop in the area during 1999 to provide protocols for the use of bioassays and chemical techniques to assess potential damage to marine ecosystems in tropical areas.

Funds have been obtained to hold the workshop in 1999 (probably in Costa Rica). This provides an opportunity for a HOTO pilot project to study an important environmental question with implications for human health and sustainable development. The aim is to use this Meso-American Reef project as a representative example for the region, and to supply adequate training so that when the project is complete there will be sufficient local expertise to continue assessing the effects of man's activities on tropical ecosystems. Whether or not this GIPME-led initiative becomes a HOTO pilot project will be discussed at a GIPME/HOTO meeting in December 1998. It could become a joint C-GOOS/HOTO pilot project.

7.2.7 Adriatic Sea (Malone)

7.2.7.1 Introduction

The Adriatic Sea is a semi-enclosed body of water with densely populated coastal watersheds. Surrounding States belong to the industrially developed and developing world with established or growing economies. The region is characterized by intensive land-based and sea-based activities including expanding tourism, a vibrant fishing industry, and multinational economic trade. The success of these industries depends on a healthy marine ecosystem.

Nutrient enrichment is suspected of causing profound changes in the health of the northern Adriatic Sea. Mucilage events, oxygen depletion of bottom water and harmful algal blooms may be indicators of eutrophication. Nutrient enrichment may also be a factor in the "successful" invasion of nonindigenous species and in habitat loss. Furthermore, the effects of nutrient enrichment can be exacerbated by overfishing. Episodic meteorological events and longer term climate change compound the environmental effects of human activities on local to regional scales. In addition to their profound effects on the habitats, biodiversity and productivity of coastal ecosystems, environmental changes such as these will make coastal ecosystems more susceptible to natural hazards, more costly to live in, and of less value to the national economy.

A major scientific challenge arising from human activities in the coastal zone is the development of a predictive understanding of the relationships between land-use practices in coastal drainage basins (population growth, agriculture, urbanization, deforestation, etc.) and changes in the water quality and living resources of their receiving waters (bays, estuaries, coastal seas). The northern Adriatic (NA), like many coastal aquatic systems, has been subjected to increases in nitrogen and phosphorus inputs that reflect changes in land-use patterns as human population densities in coastal watersheds (catchment areas, drainage basins) have increased. In addition to point sources (e.g., sewage outfalls), diffuse inputs of nitrogen and phosphorus from the Po River and other river systems are of particular concern.

In terms of the effects of nutrient enrichment, it is very important to note that approximately half of nutrient load to the northern Adriatic enters the system in the northern reaches of the system (north of the Po River discharge), including rivers discharging into the Gulf of Trieste. In contrast to nutrients delivered by the Po River which have a short residence time in the northern Adriatic, these nutrients are likely to be retained and recycled within the northern Adriatic before being lost to the atmosphere (denitrification), buried in the sediments (N, P, and Si), or transported into the southern reaches of the Adriatic (N, P and Si). Thus, the effects of these inputs (north of the Po) on eutrophication in the northern Adriatic may be much greater than for nutrients delivered by the Po.

7.2.7.2 Goals

This pilot project is conceived as one research component of the proposed Coordinated Adriatic Observing System (CAOS). It will address the following related questions:

(i) Do historical data bases and sediment records reveal past trends that can be related to anthropogenic activities and aid in the design of CAOS?

(ii) How does the NA respond to nutrient loading (nitrogen, phosphorus and silicon) in terms of variations in primary productivity and biomass, community structure (microbes to fish), nutrient cycling, trophic interactions, and the population dynamics of gelatinous zooplankton and fish?

(iii) How are changes in ecosystem dynamics (question #2) related to the development and magnitude of mucilage events, oxygen depletion, harmful algal blooms, and mass mortalities of macrobenthic and pelagic organisms (indicators of ecosystem health)?

(iv) What are the causal linkages and quantitative relationships between variations in nutrient input and indicators of ecosystem health?

(v) How do changes in ecosystem health impact on the economies of the surrounding States in terms of fisheries (including mariculture), shipping and tourism?

The development of meaningful answers to these questions will require a monitoring network that includes the entire Adriatic Sea (high resolution) as well as the Mediterranean Sea as a whole (lower resolution); research programmes that employ both observation, experiments and modeling to determine the causes and effects of environmental phenomena revealed by the monitoring network; and knowledge of the physical setting. The large scale problem of the Mediterranean Sea is being addressed by the Mediterranean Forecasting System (a joint EuroGOOS-MedGOOS project funded by the EC) which will provide the information required to understand local changes within the Adriatic in the context of changes occurring on the larger scale of the Mediterranean Sea (a nested, hierarchical approach). The physical setting of the Adriatic Sea as a whole is of fundamental importance to the development of meaningful answers to the environmental questions posed above. A quantitative understanding of the mean circulation, deviations from the mean (especially lateral west-east transport and advective exchanges between the shallow northern region and the deeper southern region), and of the processes responsible for these deviations will be required. Major forcings (e.g., river flows, wind stress, solar radiation, atmospheric deposition, tides) must be monitored on a regular basis. This, and the monitoring of changes in water quality parameters (e.g., nutrient concentrations, primary productivity, grazing rates) and indices (e.g., dissolved oxygen, turbidity, mucilage, HAB species, mass mortalities of macrobenthic organisms and fish) are key components of the proposed Coordinated Adriatic Observing System (CAOS). In this context, a research programme to answer questions related to the effects of nutrient enrichment on the nutrient and trophic dynamics of the northern Adriatic will soon be proposed as a major research component of the CAOS.

7.2.7.3 Background

The genesis of the proposed pilot project began in 1995 with a workshop sponsored by Croatia, Slovenia and the U.S. and attended by scientists from Austria, Croatia, Slovenia, Italy and the United States (Malone et al., 1996). The workshop stimulated a collaboration between the scientists who participated in the workshop that led to the publication of "Ecosystems at the Land-Sea Margin: Drainage Basin to Coastal Sea" (Malone et al., 1998). The workshop was a forum for the comparative analysis of nutrient loadings, transport pathways, nutrient cycling, trophic levels, water quality and fisheries of the Chesapeake Bay (CB) and the northern Adriatic Sea (NA). The analysis illustrated the importance of research and monitoring as a means for developing the information base needed to formulate and implement a comprehensive strategy for coordinated management of land-use practices, water quality and fisheries.

Attempts to compare and contrast the current status of the NA and CB were plagued by the problem of undersampling at all levels from the quantification of inputs to the ecological processes responsible for changes in water quality and fisheries. This was found to be especially true of the NA where the need for coordinated and interactive research and monitoring programmes to assess and forecast the effects of land-use practices on water quality and fisheries is especially acute. A few examples are given here to illustrate this point.

(i) Assessment and management of the effects of nutrient inputs on water quality and living resources require both the formulation of annual nutrient budgets that quantify sources and sinks and the elucidation of the causal relationships that govern the relationships between sources and sinks (the ecological linkages). At present, budgets for nitrogen, phosphorus and silicon of the NA cannot be done with known levels of statistical confidence primarily because important sources have not been quantified with sufficient resolution or over sufficient periods of time (e.g., riverine inputs, ground water discharge, and atmospheric deposition); advective exchanges with the greater Adriatic Sea to the south and lateral (west-east) circulations are not well understood; and the effects of sedimentation and benthic-pelagic coupling on internal storage of nutrients and the effects of fisheries and fish migrations on nutrient inputs and exports are unknown.

(ii) In terms of the responses to nutrient enrichment, the lack of data from the plume of the Po River and the apparent patchiness of ecosystem level expressions of nutrient enrichment (e.g., oxygen depletion, HABs, mucilage production) in the NA are major problems. Estimates of phytoplankton productivity of the NA as a whole are uncertain, largely because of undersampling in both time and space (vertically and horizontally). In addition, there are few measurements of benthic microalgal production even though it is likely to be a significant source of organic matter within the NA. The Po River is the largest single source of land-derived nutrients and phytoplankton production in its plume is a major source of organic matter to the NA, yet the production associated with the plume and the fate of this production in neither well quantified or understood. Understanding the fate of riverine nutrient inputs and associated phytoplankton production within the NA is key to understanding and quantifying the linkages between nutrient inputs, hypoxic events, "mare sporco", harmful algal blooms, and changes in fish stocks. Knowledge of how the Po River outflow interacts with patterns of circulation on a range of scales (from microscale turbulence to mesoscale eddies) under different forcing regimes is of fundamental importance.

(iii) Despite repeated massive outbreaks of jellyfish, their public health risks, their impact on tourism, and their potential effects on fisheries, there has been no systematic study of the abundance and distribution of gelatinous zooplankton in the Adriatic. There are good reasons to suspect causal linkages between nutrient enrichment, overfishing and the frequency and magnitude of jellyfish outbreaks. However, an objective evaluation of these possibilities cannot be made due to the lack of long-term data on their abundance and distribution in the context of variations and trends in nutrient loading and the population dynamics of fish and shellfish prevents.

(iv) Finally, the challenges to fisheries management in the Adriatic are similar to those of most exploited coastal ecosystems. In addition to better measures of fishing effort, there is an immediate need for more systematic and frequent stock assessments performed in the context of observation programmes that quantify variations in key environmental variables and the abundances of prey and predators. Traditional fisheries management approaches may suffice in the short-term, but adaptive, multispecies management to protect and restore water quality and habitat (especially habitats for breeding and early development, e.g., sea grasses, lagoons) are the keys to sustainable fisheries.

The results of the 1995 workshop laid the foundations for a workshop on the "Coordinated Adriatic Observing System" (CAOS) which was co-sponsored by the Italian National Research Council, the Italian Ministry of Foreign Affairs, the Croatian Ministry of Science and Technology, and the Slovenian Ministry of Science and Technology (21-22 October, 1998, Trieste, Italy). The goal is to design an observation system to address (i) environmental problems in the NA (land-based sources of pollution; human and ecosystem health; biodiversity of coastal areas); (ii) larger scale issues (susceptibility to natural hazards such as storm surges, influence of climate change; eutrophication of the Adriatic as a whole, mucilage events, outbreaks of jellyfish); and (iii) fishing and biodiversity (habitat loss; declines in commercial fisheries; conservation and biodiversity).

The 1995 workshop has also led to the organization of a second workshop on "Nutrient and Trophic Dynamics in the Northern Adriatic Sea and Their Impact on Fish Production" (9-16 May, 1999, Rovinj, Croatia). The workshop will build on the experience, contacts and outcomes of the 1995 workshop and the 1998 CAOS workshop. The proposed research programme is expected to be an integral part of CAOS in that it will provide much of the scientific basis for the monitoring component. It will focus on the fundamental research questions identified in the 1995 workshop and will set priorities for future research and monitoring as related to nutrient cycling and production dynamics in the northern Adriatic Sea. The primary objectives are:

(i) Refine fundamental research questions and identify specific information gaps, technological needs and priorities for future research and monitoring on the interactions of nutrient cycling, trophic interactions and fish production that will be critical for effective management and planning in the region.

(ii) Build on the experiences, contacts and outcomes from the 1995 workshop to provide a mechanism for scientific interaction and exchange on environmental issues in the northern Adriatic Sea.

(iii) Recommend ways to effect coordinated, cost-effective research, monitoring and data management (quality control, archival and dissemination) in the northern Adriatic.

(iv) Evaluate the feasibility and advantages of including the northern Adriatic region in other international programmes such as the International Coastal Global Ocean Observing System (C-GOOS), the International Long-Term Ecological Research Programme (I-LTER), and GLOBEC.

(v) Produce an integrated work plan (and information brochure for the public) which can help direct funding efforts in the region. This will be a distinct, articulated methodological report that details, in modular form, specific research and monitoring activities that are responsive to the needs of end user groups.

(vi) Initiate a training process (including scientific exchange) that will add new disciplinary expertise to the region and ensure a sustainable programme to follow up on workshop recommendations.

The workshop will provide a forum in which leading scientists will define how we can best monitor and research key factors in nutrient inputs, trophic dynamic fisheries, and patterns of nutrient recycling and physical forcing factors. A central issue is the "paradox of nutrient enrichment." In contrast to global scale comparisons that show positive correlations between nutrient input and fish production, nutrient enrichment is often associated with loss of habitat, bottom water hypoxia, increases in HABs, gelatinous zooplankton outbreaks, fish kills, and declines in tourism and marketable seafood products. Many of these problems have been observed in the NA, including mucilage events and changes in the structure of food webs that support commercial fisheries.

7.2.7.4 Pilot Project Design

It was recognized that there is a need to link bottom-up (measurements) and top-down (user needs) perspectives (the end-to-end, user driven approach of GOOS). The following is a first cut at using the C-GOOS design process to address one issue, the problem of oxygen depletion in bottom waters of the northern Adriatic. It is intended to be a starting point for discussion that will stimulate debate and lead to a more systematic and comprehensive pilot project design.

Pilot Project Design Table for Hypoxia/Anoxia.

Prediction	Lead Time	Model Type	Model[1] Inputs	Model Outputs
extent of hypoxia in time-space	near real-time to annual	mass balance, numerical	riverine & atmospheric freshwater & nutrients, wind stress, currents, tides, T-S, PAR, Chl	fields of flow, Chl & dissolved oxygen

Analysis of Input Variables: variable to be measured (model inputs), scales of measurement (required resolution in time and space of measurements, areal coverage and temporal duration of measurements; f - frequency, d - duration, ar - aerial resolution), a ranking of each variable in terms of its importance to the modeling effort (impact), the feasibility of measuring each variable, and availability of proven techniques and technologies. The duration is muli-year in each case.

Variable	Scales	Rank	Feasibility	Technology
Q_f Nutrient flux	f: daily	high	high	flow meter, nutrient concentration
Atm deposition, Nutrient flux	f: daily over water ar: 10 sites	high	moderate	wet and dry deposition, nutrient concentration
Winds	f: hourly, surface over water, ar: 10 sites	high	high	anemometer, satallite scatterometer (ADEOS)
Tides	f: hourly ar: 5 sites	high	high	tide gauges
PAR	f: surface continuous; vertical profiles monthly ar: 10 sites	high	high	moored instrument; spectral radiometer
T, S	f: hourly vertical profiles ar: 10 sites; monthly aerial distribution	high	good	moored instruments, 3-5 depths; ship, CTD; satellite (AVHRR)
[Nutrients]	f: daily vertical profiles ar: 10 sites; monthly aerial distribution	high	fair good	moored instruments, 3-5 depths; ship, bottle samples
[Chlorphyll-a]	f: daily vertical profiles ar: 10 sites; monthly aerial distribution	high	fair good	moored instruments, 3-5 depths; satellite (SeaWiFS); ship, bottle samples

[1] Given basin geomorphology, these are the minimum. For example, satellite altimeter data (e.g., Topex) could be used to estimate surface currents. Submodels include circulation, vertical exchange, phytoplankton production, benthic-pelagic coupling and oxygen demand.

7.2.7.5 Relationship to other programmes

A EuroGOOS-MedGOOS pilot project has been funded by the EC as the first step in the full scale design and implementation of "The Mediterranean Forecasting System" (MFS). The broad goal of the MFS is to explore, model and quantify the potential predictability of the ecosystem fluctuations at the level of primary producers from the overall basin scale to the coastal-shelf areas on time scales of weeks-months through the development and implementation of an automated monitoring-nowcasting-forecasting observation system with a modeling component that connects measurements (monitoring) to products (e.g., predictions, visualizations). The achievement of this ambitious goal will depend on the design and implementation of a hierarchy of nested observation systems from the scale of the Mediterranean (MFS) to the local and regional scale of continental shelves and seas. The Coordinated Adriatic Observing System satisfies the need for higher resolution local-regional scale components of the MFS.

The Land-Ocean Interactions in the Coastal Zone Programme (LOICZ) of IGBP was established to determine at regional to global scales (1) the fluxes of material between land, sea and atmosphere through the coastal zone, the capacity of coastal systems to transfer and store particulate and dissolved matter, and the effects of changes in external forcing conditions on the structure and function of coastal ecosystems; (2) how changes in land use, climate, sea level, and human activities alter the fluxes and retention of particulate matter in the coastal zone; (3) how changes in coastal systems, including responses to varying terrestrial and oceanic inputs of organic matter and nutrients, affect the global carbon cycle and trace gas composition of the atmosphere; and (4) how responses of coastal systems to global change will affect the habitation and usage by humans of coastal environments. ELOISE (European Land-Ocean Interaction Studies), the European contribution to LOICZ, consists of 29 research projects organized into three working groups: biogeochemical fluxes and cycling, ecosystem structures, and modeling and data management.

The Global Ocean Ecosystem Dynamics (GLOBEC) Programme, established by SCOR and the IOC in 1991, addresses the need to "understand how changes in the global environment will affect the abundance, diversity and production of animal populations comprising a major component of the ocean's ecosystems." The

GLOBEC science plan emphasizes the need for basic research to quantify the dynamics of zooplankton populations in general and importance of predator-prey interactions (phytoplankton-zooplankton-fish) and physical forcings in particular. These goals are to be achieved by (1) building a foundation for global ecosystem models through re-examination of historical data bases, synthesis and integration; (2) conducting process studies; (3) developing predictive modeling capabilities through interdisciplinary, interactive modeling and observations; and (4) cooperating with other ocean, atmosphere, terrestrial and social global change efforts to assess feedback effects of larger scale changes in the structure of the biosphere.

LOICZ, GLOBEC, and CAOS clearly have elements that are relevant to each other. The quantification of fluxes of nutrients and water from coastal drainage basins to estuaries and the coastal ocean and of nutrient budgets for coastal ecosystems are major goals of LOICZ. GLOBEC emphasizes the roles of physical processes and zooplankton in the trophic dynamics of food webs that support marine fisheries. Major goals of CAOS include quantifying nutrient fluxes from land to water and the effects of anthropogenic nutrient enrichment and buoyancy flux on water quality and fisheries. Clearly, coordination with the MFS, LOICZ and GLOBEC must be a high priority of CAOS. Coordination will include the design and implementation of research projects and the exchange of data and information to achieve the related objectives of both programmes.

7.2.8 CARICOMP (Ogden)

The Caribbean Coastal Marine Productivity Programme (CARICOMP) is a regional network of laboratories, parks and reserves formed to study land-sea interaction processes, to provide educational opportunities for Caribbean marine scientists and resource managers, and to integrate appropriate scientific information into management. The programme focusses on understanding the productivity, structure, and function of the three main coastal ecosystems in the Caribbean: mangroves, seagrasses and coral reefs.

CARICOMP grew out of the Association of Island Marine Laboratories, whose interaction was stimulated some years ago by the almost complete Caribbean-wide extinction of the sea urchin *Diadema*. In 1985, under the umbrella of UNESCO's Coastal Marine (COMAR) programme, CARICOMP was formed to coordinate and conduct monitoring and allied research. UNESCO's COMAR programme has now evolved into the UNESCO Project on Environment and Development in Coastal Regions and Small Island States (CSI), which has more of a social sciences remit but which still provides a UNESCO umbrella for CARICOMP, including support for workshops and meetings. Funding for the programme is provided by the MacArthur Foundation. Although the scope of its activities is much broader, CARICOMP is one of the nodes of the GCRMN (see 5.3). CARICOMP has facilitated cooperation on various studies of the coastal zone, developed a basic (Level 1) manual on coastal monitoring measurements to ensure a standard approach to data collection, supports capacity building, and maintains a data base at the University of the West Indies in Kingston, Jamaica. These data provide the basis for assessing long term trends, establishing base-line statistics on biodiversity, and detecting threshold responses of ecosystems to environmental changes.

The CARICOMP Steering Committee is exploring the possibility of becoming a C-GOOS programme. Does CARICOMP, an established and growing coastal network, qualify as a C-GOOS pilot project? The CARICOMP model is attractive and may have wider application, especially if it is adopted by C-GOOS. In addition, CARICOMP should seek an association with IOCARIBE, the IOC regional group responsible for Caribbean marine science and technology. CARICOMP could ask that this matter be raised at the IOCARIBE meeting proposed for early 1999. It would also be useful for CARICOMP to be involved in planning for the Caribbean GOOS workshop being planned for early 1999 by the GPO and IOCARIBE.

7.2.9 Seagrass Network (SEAGNET) (Koch)

Seagrasses occur along the coastlines of all continents except in polar regions and are considered to be one of the planet's most productive plant systems. It is currently estimated that the seagrass standing crop stores about 4% of the total carbon. They stabilise sediments and act as habitat for many economically important species. In recent years seagrass beds have been declining due largely to coastal development and eutrophication. They may also be sensitive to small increases in sea level which would reduce the availability of light. Because seagrass beds are not monitored it is not possible to quantify the rates and extents of loss.

Recognizing the need for global observations, SEAGNET was established in April 1998 at the 3rd International Seagrass Biology Workshop in Manila, Philippines (151 seagrass scientist from 28 nations). The SEAGNET mission is to (i) develop an effective observation system to provide coastal managers with reliable information on seagrass ecosystems worldwide; (ii) promote the comparative analysis and synthesis of data across SEAGNET sites; (iii) to enhance training and education in comparative methodologies and technologies, especially in developing countries; (iv) facilitate the interaction among participating researchers across disciplines and sites; (v) develop models able to predict the effect of global changes on seagrasses; (vi) disseminate information about the importance and need for preservation of seagrasses.

To achieve these goals, SEAGNET has identified the following priorities: (i) revise the 1990 UNESCO publication on "Seagrass Research Methods" to include an updated description of standard methods for monitoring seagrass beds and reporting results; (ii) create a global coordination mechanism, supported by regional offices and individual institutions; and (iii) establish monitoring sites and a data management programme, train observers, and disseminate information and products.

As a C-GOOS pilot project, SEAGNET will (i) document the current distribution and abundance of sea grasses and establish the seagrass observing system to quantify changes; (ii) determine the role of seagrasses in the global carbon cycle; (iii) evaluate the relationships between nutrient enrichment, sea-level rise, and changes in seagrass distribution; and (iv) develop models to predict global changes in the distribution of seagrass. Products will include GIS maps showing seagrass distribution, abundance and biomass and how these properties change over time in relation to changing environmental conditions such as sea-level and water clarity.

The advantages to SEAGNET of an association with C-GOOS would be to obtain appropriate guidance from C-GOOS experts on the design, implementation and funding of an observing system for this important ecosystem. The advantages to C-GOOS of an association with SEAGNET would be to ensure inclusion within C-GOOS of the main international body concerned with a major global coastal ecosystem. This would be consistent with the adoption of the GCRMN by GOOS and C-GOOS in the case of coral reefs.

7.2.10 Southwest Atlantic Pilot Project (Marone)

At the suggestion of Tom Malone, Eduardo Marone introduced the idea of developing a C-GOOS Pilot Project , the Regional Network on Natural Hazards Warning System, the development of which had been discussed in Curitiba on October 26-28th 1998 (see section 4 and Annex VII). The next steps will determine how such a regional observing system would interface and coordinate with several other related projects, programmes and activities. These include El Niño forecasting groups, GLOSS and its network of sea-level stations, meteorological services and stations, the IOC-EU capacity building programme, the IOC-HAB network for South America (FANSA) and relevant UNEP Regional Seas programmes (Annex X).

In discussion, it was recognized that since the network is at a very early stage in its development, some time will be required before it has sufficient shape to be considered as a C-GOOS pilot project. As Eduardo Marone put it, we are really at the stage of looking at the pilot for a pilot project.

The organizers of the programme will try to develop the project along C-GOOS lines, and will report on their progress at C-GOOS-III. To take the programme forward, they plan to hold a regional meeting, possibly in Cartagena, Colombia, in September 1999, or following the LOICZ Open Science meeting that will be held in Bahia Blanca, Argentina, in November 1999.

7.2.11 Radar Ocean Sensing (Guddal)

An important future role of C-GOOS will be to provide advice on the most appropriate operational tools for coastal monitoring. Radar Ocean Sensing (Rose) is a likely candidate. ROSE uses coastally based HF radar to determine sea conditions (wind, waves, tides, surges, currents) as the basis for coastal forecasts for shipping interests and other users. The system consists of radars that cover areas from 2-40km offshore and high resolution numerical models which assimilate the data and simulate and forecast wave spectra and currents. EuroROSE is a European proposal to develop ROSE as a tool for use by Vessel Traffic Services operators, harbour authorities, and coastal managers to monitor and predict significant weather and ocean conditions with high time-space resolution in selected regions where marine operations are especially active or sensitive. EuroROSE started in October and will run for three years. This an exciting technology offering considerable potential for coastal monitoring and modeling. In this connection it might prove useful for C-GOOS to develop a link to the CMM's ROSE subgroup.

7.2.12 Vietnam Coastal Disaster Warning System (Guddal)

Typhoons regularly cross Vietnam, damaging property and infrastructure and killing people. The Norwegian Government has been advising Vietnam on the development of a 'Strategy and Action Plan for Mitigating Water Disasters in Vietnam'. Its goals are to (i) to establish procedures for end-to-end data-to-product management, (ii) establish professional reporting and auditing procedures, (iii) establish professional Quality Assurance procedures for the whole production line from data to product, (iv) build long-term planning capabilities, (v) provide training in all aspects of the production line, (vi) establish preparedness procedures for typhoon incidents, (vii) update and enhance international cooperation with CMM and GOOS, (viii) select and apply a numerical storm surge model assimilating typhoon data. Clearly, this project has many of the attributes of a C-GOOS type of project, and the C-GOOS Panel may wish to incorporate lessons learned into the design and implementation plans of C-GOOS.

In Vietnam there is a good basis for the design of an observing network for forecasting storm surges associated with typhoons. There is a database containing basic statistics on sea-level under storm and non-storm conditions, and there is a network of offshore buoys equipped with meteorological and oceanographic sensors. However, the infrastructure and models required to process the data and make marine forecasts do not exist, and, while the sea-level data are archived, most of the buoy data seem to be lost. The buoys also suffer from interference by fishermen and have to be protected by the navy. The problem of buoys being vandalised, damaged, set adrift or stolen by fishermen is common, and has given many headaches for instance to the TAO Implementation Panel. To help protect TAO buoys an information leaflet explaining in several languages the benefits that the buoys bring to them has been widely distributed to fishermen in the equatorial Pacific. C-GOOS needs to follow this model.

Johannes Guddal suggested that it might be worthwhile inviting the Vietnamese to attend a future C-GOOS meeting to discuss the processes C-GOOS might use, and the possible difficulties that might be encountered, in setting up C-GOOS projects in other developing countries. This would provide another useful opportunity for C-GOOS to interact with the user community. C-GOOS might also wish to consider adopting this working project as a useful demonstration project to encourage other countries along a similar path. He offered to cover the costs of the attendance of Vietnamese representatives at such a meeting.

8. INTERSESSION ACTION PLAN II: DEVELOPMENT OF THE STRATEGIC PLAN

8.1 FORMATS FOR THE PREPARATION OF PROJECT PROPOSALS

Full proposals are to be prepared during the intersession between C-GOOS II and C-GOOS III. The proposals will be reviewed by the Panel at C-GOOS III and priority pilot projects to be included in the Strategic Design Plan will be selected. As agreed to by the Panel, all proposals will follow the following format:

I. Issues Addressed and Their Significance
II. Users and Products of the Observing System
III. Relationship to the C-GOOS Global Network (to be completed at C-GOOS III; Pilot Projects only)
IV. Project Design (Procedures given in section 6)
    A. Issues to be Addressed (see Table I)
    B. Final Prediction and Lead Time
    C. Models to be Used, Model Variables and Outputs
    D. Feasibility and Cost-Benefit Analysis
V. R & D needs (given the issue to be addressed, what must be done to make the observing system fully operational)
    A. Measurements
    B. Models
    C. Products
VI. Data and Information Management
    A. Elements
    B. Data Sharing Policy
VII. Capacity Building
    A. Needs and Priorities
    B. Plans

Action 1: Tom Malone and Colin Summerhayes to develop criteria for being accepted as a C-GOOS project and for ranking pilot projects in terms of significance and chance of success.

8.2 GOALS AND BENEFITS OF C-GOOS

Action 2: Tom Malone and Colin Summerhayes to define the goals and benefits of C-GOOS.

Action 3: Johannes Guddal to aid C-GOOS Panel in identifying services and products needed by the user community and explore the need for and impact of a GOOS Services and Products Bulletin (3.6).

8.3 DESIGN CRITERIA FOR INTEGRATED, MULTI-DISCIPLINARY OBSERVING SYSTEM

8.3.1 The Global Network

Action 4: Keith Thompson (chair), Julie Hall, Dale Kiefer, Eduardo Marone, John Ogden, Jozef Pacyna, Osvaldo Ulloa, Steven Walker, Wang Hong, Adriana Zingone will draft the design plan for the Global C-GOOS Network.

8.3.2 Pilot Projects

Action 5: Oswaldo Ulloa, Sinjae Yoo and Janet Campbell, Adriana Zingone and Ed Gomez, Tony Knap, Tom Malone, John Ogden, Evamaria Koch and Carlos Duarte, Eduardo Marone, Johannes Guddal, and Larry Awosika will prepare full proposals using the format given in section 8.1 for review at C-GOOS-III.

8.3.3 Effecting Critical Linkages Among User Groups

Action 6: Julie Hall (chair), Bud Ehler, Ed Gomez, Johannes Guddal, and Steve Walker will review the Ehler report "Recommendations for Activities the Will Promote Functional Linkages among Scientific and User Groups" and tune it to the needs of C-GOOS for the purposes of formulating design and implementation plans and identifying R&D needs for the full scale implementation of C-GOOS (section 3.7)

8.3.4 Effecting Critical Linkages with Related Programmes

The design of C-GOOS will include plans for the development of critical linkages with related programmes and activities and the rationale and goals of such linkages. This will include, as appropriate, partnerships with HOTO, LMR, OOPC, the national and regional GOOS programmes, GCOS, GTOS, and the UNEP Regional Seas programme. LOICZ and GEOHAB provide much of the scientific underpinning of C-GOOS and the working relationship between C-GOOS and these research progammes will be defined.

Action 7: Tom Malone (chair)(U.S. GOOS, GEOHAB, LMR), Larry Awosika (GOOS-Africa), Tony Knap (HOTO), Eduardo Marone (GOOS-Brazil and regional programmes in S. America), George Needler (OOPC), Jozef Pacyna (LOICZ and EuroGOOS), B.R.Subramanian (GOOS activities in India and the region), and Wang Hong (NEARGOOS), to identify critical linkages.

Specific issues that came up during C-GOOS II and should be addressed include the following:

(i) Jozef Pacyna will continue to work with Chris Crossland to establish areas where joint projects should be initiated and formal linkages between C-GOOS and LOICZ are required and to recommend mechanisms by which these will be accomplished. This will be an important item on the agenda for C-GOOS III and the GSO will invite Chris Crossland to participate in C-GOOS III (5.4)

(ii) The problem of carbon storage in coastal ecosystems should be addressed as part of the planned working relationship between C-GOOS and LOICZ (3.5).

(iii) Keith Thompson, Stephen Walker and Julie Hall will review the report, The Science Base for EuroGOOS, and summarize those aspects that are relevant to C-GOOS, especially for the purposes of formulating design and implementation plans and identifying R&D needs for the full scale implementation of C-GOOS (5.2.4)

8.4 COASTAL TYPOLOGY: FUNCTIONAL GROUPS OF COASTAL ECOSYSTEMS

Action 8: Jozef Pacyna (chair), Carlos Duarte and Larry Awosika will develop a coastal typology for C-GOOS. This will include an analysis of the coastal typology formulated by LOICZ.

8.5 CORE MEASUREMENTS AND R & D NEEDS

Panel members agreed that an inter-sessional working group should develop a paper for C-GOOS-III on emerging technologies. The group should evaluate among other things the EuroGOOS Technology Plan and journals like EEZ Technology.

Action 9: Colin Summerhayes (chair), Johannes Guddal, Janet Campbell, Dale Kiefer, Tony Knap, and Sinjae Yoo will prepare a report that assesses emerging technologies in terms of their importance to the design and implementation of C-GOOS.

8.6 CAPACITY BUILDING

Action 10: Ed Gomez (chair), Larry Awosika, Eduardo Marone, B.R.Subramanian, and Colin Summerhayes will prepare a report that integrates the "Principles of GOOS Capacity Building" with the specific requirements of C-GOOS as spelled out in section 5.6. This may include plans for organizing C-GOOS training modules such as those developed by GLOSS (5.6).

9. OTHER BUSINESS

9.1 C-GOOS VICE-CHAIR

Recognizing that it would be useful for C-GOOS to have an appropriate stand-in for the chairman on those occasions when he is unable to represent C-GOOS, **Tom Malone recommended that Eduardo Marone serve as Vice Chair. The Panel endorsed this proposal and Eduardo agreed to take on this responsibility.**

9.2 ACTION ITEMS FOR THE GPO

- Represent C-GOOS interests in the IOC-IGU programme and keep C-GOOS informed of IOC-IGU developments (3.1.3).
- Colin Summerhayes will try to attend the December (1998) London meeting (3.2).
- Finalise arrangements to compile the inventory (3.4).
- Invite Phil Woodworth to attend C-GOOS-III (3.5).
- Provide panel members with copies of GOOS overheads (3.7).
- Ask GSC Chair to publish GSC Capacity Building Strategy whole (3.7).
- Work with Eduardo Marone to develop effective linkages with the IOC-EU oceanographic and IOC-HAB networks for South America (FANSA) (section 4 and 7.2.10).
- Work with the GSC and I-GOOS to encourage member nations (through the IOC Assembly and other bodies) to release environmental data in a timely fashion (section 4).
- Invite a representative from GTOS to participate in C-GOOS meetings. (5.1).
- Invite a representative of the OOPC, e.g., George Needler, to C-GOOS III to update the Panel on activities of the OOPC (and CLIVAR) and to discuss opportunities for joint projects (5.1.1).
- Invite the chairman of HOTO, Tony Knap, to participate in C-GOOS III to discuss coordination and collaboration with C-GOOS on issues ranging from sampling and measurement programmes to data management (5.1.2).
- Invite a representative from the LMR panel should be invited to C-GOOS III (5.1.3).
- Provide copies of the draft J-DIMP to the C-GOOS Panel prior to GOOS III (5.1.4).
- Keep all UNEP Regional Seas Offices informed of C-GOOS activities and will invite representatives to C-GOOS panel meeting as appropriate (5.2.1).
- Request that the chairs of MedGOOS and PacGOOS invite the chair of C-GOOS or his representative to attend these workshops for the purpose of determining how best to collaborate to achieve common goals (5.2.2).

- Invite the NEAR-GOOS Chair and a NOWPAP representative to attend C-GOOS-III to consider development of joint projects in N.E.Asia (5.2.3).
- Alert the IOC Assembly, through the GSC and I-GOOS-IV, to the need for National GOOS Coordinating Committees in the region (5.2.3).
- Invite the Director of EuroGOOS to C-GOOS-III or IV (5.2.4).
- Inform the Chair of the GSC's Capacity Building Panel that Eduardo Marone agreed to be the representative of C-GOOS (5.6).
- Create a list of coastal capacity building programmes that includes a brief description of their goals and target audience (5.6).
- Advise the chair of GOSSP of the need for ocean colour and other properties from geostationary satellites (7.1).
- Draft appropriate documentation for the GSC, I-GOOS-IV and the IOC Assembly to encourage the regional Member States to establish the project; encourage UNEP to promote the concept through its Regional Seas programme; and work with WMO (e.g., Fernando Guzman and Peter Dexter) to press for commitment from Member States to a regional project (7.2.1).
- Communicate to the IOC-Executive Council in November 1998 the Panel's concerns about the storm surge proposal (7.2.4).
- Acquire a copy of the TAO Implementation Panel leaflet for fishermen for circulation to C-GOOS (7.2.11.).
- Consider inviting Vietnamese scientists to a future C-GOOS meeting (J. Guddal, 7.2.12).

9.3 ADDITIONAL ACTION ITEMS FOR THE PANEL (additional to those in section 8)

- Participants were asked to advise the GPO of the names of people who should be sent copies of GOOS 1998.
- Tom Malone (CENR) and John Ogden (coral reefs) will report on progress in the identification and use of indicators at GOOS III where the identification and use of indicators will be on the agenda (section 3.2).
- Members to advise the GPO about the monitoring programmes they know about, flagging whether they are research or operational in nature (3.4).
- John Ogden and Tony Knap will advise the GPO which foundations to approach for funding and on the preparation of proposal for assistance (3.4).
- Tom Malone will identify a C-GOOS representative to attend GLOSS-VI (3.5).
- The issue of mangrove habitat loss will be addressed at C-GOOS III. Tom Malone will identify an expert to be invited by the GPO (3.5).
- Consider inviting selected stakeholder groups to C-GOOS meetings, and involving them in development of C-GOOS design (3.7).
- Promote C-GOOS at coastal management conferences, through newsletters etc. (3.7).
- Wang Hong will convey the C-GOOS recommendations above (i-iv) to the NEAR-GOOS Coordinating Committee and will work with Sinjae Yoo to improve access to and awareness fo the NEAR-GOOS data base and to explore the possibility of the joint remote sensing project for the NEAR-GOOS region (5.2.3).
- Tom Malone will arrange for a C-GOOS paper to be given at EuroGOOS Conference in March, 1999 (5.2.4).

- C-GOOS will encourage the development of GEOHAB, and the integration of GEOHAB requirements and results into the C-GOOS design. Adriana Zingone will be the liaison for this important purpose (5.5).

- Adriana Zingone will explore the PHYTONET concept with EuroGOOS and other relevant programmes in Europe. The panel encourages the preparation of a full proposal for discussion at C-GOOS III (7.2.3).

- Eduardo Marone to try to involve meteorological offices and navies in the network (7.2.10).

- Johannes Guddal, in consultation with Tom Malone, will explore the possibility of inviting Vietnam project representatives to attend a forthcoming C-GOOS meeting (7.2.11).

9.4 ADDITIONAL PILOT PROJECTS

Larry Awosika had to leave the meeting before he could present the proposed pilot project on “Assessing Trends in Coastal Hazards and Associated Meteorological Oceanographic Processes in the IOCEA Region.” IOCEA is the IOC regional body for the eastern Atlantic, and includes west Africa. The Panel asked for it to be submitted as a full proposal as described above.

Other possible projects that should perhaps be considered at C-GOOS-III include:

- The Western Pacific Biodiversity pilot project proposal that was to have been prepared by Yoshi Shirayama, but which had to be shelved when his laboratory was demolished by a typhoon earlier this year;

- Mangroves; and

- The Gulf of Thailand project, an ongoing activity with a lot of C-GOOS characteristics, that could eventually be a core project for SEA-GOOS (South east Asia GOOS).

10. DATES AND VENUES OF FUTURE MEETING

10.1 C-GOOS-III

C-GOOS-III will take place 12-16 April. This meeting will focus on the C-GOOS strategic design plan (section 8 above). This meeting would launch the strategic plan, which should be ready in first draft by summer 1999 in time for review at C-GOOS-IV. C-GOOS-IV would then launch development of the implementation plan. As in Curitiba, it was proposed that C-GOOS-III should be preceded by a one day workshop with users.

At C-GOOS-I, the Panel had agreed that it wished to meet in different regions to promote interactions with the user groups other than scientists. Larry Awosika had offered to set up a meeting early 1999 in Lagos, Nigeria. At C-GOOS-II, the Panel considered this offer in more detail. Some concern was raised about Lagos as a destination, since U.S. travel advisories recommend against Lagos as a destination. Accepting that some ground work had already been done towards having a meeting in Lagos, Colin Summerhayes was asked to provide a list of alternative African options, with their advantages and disadvantages, for comparison with Lagos, and to use it to poll Panel members for their preferences. Options suggested included: Abidjan, Mombasa, Dakar and Cape Town.

Action 11: Colin Summerhayes to (i) produce list of African options for C-GOOS-III; (ii) poll panel members for preferences; and (iii) check the UNESCO for travel advice. Tom Malone to discuss with Larry Awosika the possible difficulties of holding a meeting in Lagos.

Action 12: Larry Awosika will work with Colin Summerhayes and Tom Malone to organize a regional user's workshop to be held as a precursor to C-GOOS III in Africa (section 3.3).

10.2 C-GOOS-IV

It was still intended to hold C-GOOS-IV in Turkey, in association with EMECS-99 (2-6 November, 1999).

ANNEX I

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ANNEX II

AGENDA

Friday 30 October 1998

09.00 **1. OPENING**

2. ARRANGEMENTS
- 2.1 ADOPT AGENDA
- 2.2 DESIGNATE RAPPORTEUR
- 2.3 LOGISTICS & ADMINISTRATION

09.30 **3. OVERVIEWS AND BACKGROUND**
- 3.1 UPDATE ON GOOS ACTIVITIES
  - 3.1.1 TOS
  - 3.1.2 GSC Meeting and GOOS 98
  - 3.1.3 Coastal Management Meeting
  - 3.1.4 ICAM Meeting
- 3.2 UN COMMISSION: INDICATORS OF SUSTAINABLE DEVELOPMENT
- 3.3 GOOS AFRICA MEETING: IMPLICATIONS

10.30 BREAK

11.00
- 3.4 GLOBAL INVENTORY OF COASTAL DATA & PROGRAMMES
- 3.5 REVIEW OF IOC DESIGN FOR COASTAL MONITORING SYSTEM
- 3.6 GOOS SERVICES MODULE
- 3.7 DEVELOPING FUNCTIONAL LINKAGES AMONG SCIENTISTS AND USER GROUPS

12.30 LUNCH

14.00 **4. REGIONAL ISSUES**
- 4.1 MUTUAL STRENGTHENING OF CAPACITIES FOR ESTABLISHMENT OF REGIONAL GOOS ON NATURAL HAZARD WARNING SYSTEMS
- 4.2 C-GOOS DEVELOPMENT IN S. AMERICA
- 4.3 GOOS BRAZIL
- 4.4 BRAZIL LTER NETWORK
- 4.5 DISCUSSION: REGIONAL PRIORITIES REQUIRING COORDINATION AMONG PROGRAMMES

15.00 BREAK

15.30 **5. RELATIONSHIP WITH OTHER PROGRAMMES**
- 5.1 GTOS, OOPC, HOTO, LMR, US GOOS
- 5.2 REGIONAL GOOS PROGRAMMES: REGIONAL SEAS, EUROGOOS, NEAR-GOOS
- 5.3 LOICZ
- 5.4 GCRM, CARICOMP AND C-GOOS
- 5.5 GIPME AND HOTO
- 5.6 CAPACITY BUILDING IN C-GOOS
- 5.7 US C-GOOS: MTS & *IN SITU* SENSING WORKSHOP
- 5.8 DISCUSSION: EFFECTING CRITICAL LINKAGES AMONG PROGRAMMES

17.30 ADJOURN

Saturday 31 October 1998

09.00 **6. IMPLEMENTING THE GOOS END-TO-END APPROACH**
- 6.1 PILOT PROJECT DESIGN
- 6.2 COST-BENEFIT ANALYSIS OF MEASUREMENTS
- 6.3 DISCUSSION: FINALIZING THE PILOT PROJECT DESIGN PROCESS & COST-BENEFIT ANALYSIS; GUIDELINES FOR SELECTING PILOT PROJECT TO IMPLEMENT

10.30 BREAK

11.00
- 6.5 ENVIRONMENTAL ANALYSIS SYSTEM

12.00 LUNCH

13.30 **7. POTENTIAL PILOT PROJECTS**
- 7.1 EASTERN S. PACIFIC
- 7.2 REMOTE SENSING: ALGORITHM DEVELOPMENT FOR COAST WATERS
- 7.3 WESTERN PACIFIC BIODIVERSITY, DIWPA
- 7.4 HABs
- 7.5 NATURAL DISASTERS; DISASTER MITIGATION
- 7.6 NETWORKING METADATA

15.00 BREAK

15.30 **8. NEW POTENTIAL PILOT PROJECTS**
- 8.1 BLACK SEA
- 8.2 NORTHERN ADRIATIC
- 8.3 CARIBBEAN
- 8.4 SEAGNET
- 8.5 ROSE
- 8.6 VIETNAM COASTAL DISASTER WARNING SYSTEM
- 8.7 DISCUSSION: SETTING PRIORITIES

17.30 ADJOURN

Sunday 1 November 1998

09.00 **9. C-GOOS STRATEGIC PLAN**
- 9.1 GOALS AND BENEFITS OF C-GOOS
- 9.2 DESIGN CRITERIA FOR INTEGRATED, MULTI-DISCIPLINARY OBSERVING SYSTEMS
- 9.3 COASTAL TYPOLOGY: FUNCTIONAL GROUPS OF COASTAL ECOSYSTEMS

10.30 BREAK

11.00
- 9.4 CORE MEASUREMENTS AND R&D NEEDS
- 9.5 CAPACITY BUILDING
- 9.6 PRIORITY PILOT PROJECTS

12.00 LUNCH

14.00 **10. INTERSESSION ACTION PLAN II (GOALS AND ASSIGNMENTS)**

11. OTHER BUSINESS

12. DATES AND VENUES OF FUTURE MEETINGS
- 12.1 C-GOOS-III
- 12.2 C-GOOS-IV - EMECS 99

17.00 ADJOURN

ANNEX III

LIST OF DOCUMENTS[1]

1. Report of C-GOOS-I meeting (April 1998)
2. GOOS News 3, 4, and 5
3. The 2-page GOOS flyer in English and Spanish
4. The G3OS Brochure
5. Draft of the GOOS AFRICA Report of the PACSICOM meeting (Maputo, July 1998)
6. Proposal for a Global Coastal Monitoring System (see Annex V); (C.Summerhayes)
7. Recommendations for Activities that will Promote Functional Linkages Among Scientific and User Groups (see Annex VI); (C.Ehler)
8. Report of the LMR Meeting (March 1998)
9. Coastal GOOS in Context (see Annex VIII); (T.Malone)
10. The EuroGOOS Science Plan
11. Components and Status of UNEP Regional Seas Programme (see Annex X); (A.Dahl and C.Summerhayes)
12. LOICZ - C-GOOS Linkage: copy of 8/4/98 e-mail from C.Crossland to T.Malone
13. Working Document on Possible Cooperation between C-GOOS and LOICZ (see Annex XI); (J.Pacyna et al)
14. Principles of GOOS Capacity Building (see Annex XII); (W.Nowlin)
15. Background to the Pilot Project Design Tables (draft); (K.Thompson)
16. Project Proposal on Storm Surges for the Northern Part of the Indian Ocean (IOC/WMO)
17. Possible Methodology for Evaluating Types of Measurement (draft); (J.Hall)
18. The GOOS Services Module (summary); (J.Guddal)
19. Report on the Workshop on the Mutual Strengthening of Capabilities for the Establishment of a Regional Network on Natural Hazards Warning System (draft) (see Annex VII); (E.Marone et al)
20. *In situ* data Needed to Support the Development of Algorithms for Ocean Colour Remote Sensing in Coastal Regions: a Proposed Pilot Project for C-GOOS; (S.Yoo and J.Campbell)
21. GEOHAB: Global Ecology and Oceanography of Harmful Algal Blooms; Executive Summary: (A.Zingone)
22. C-GOOS Pilot Project on Harmful Algal Blooms in the Indo-Pacific Area; (A.Zingone)
23. The PHYTONET Proposal; (A.Zingone)
24. The Adriatic Sea and Coastal GOOS: (T.Malone)
26. Thoughts on Networking Data for Coastal GOOS: (S.Walker)
27. CARICOMP: (J.Ogden)

[1] This list is for reference only. No stocks of these documents are maintained, except the Summary Report.

28. Global Seagrass Monitoring Network (Seagnet): a Pilot Project Presented to the Coastal Global Ocean Observing System (C-GOOS); (E.Koch et al)

29. ROSE; a CMM Subgroup on Radar Ocean Sensing; (J.Guddal)

30. Strategy and Action Plan for Mitigating Water Disasters in Vietnam; (J.Cuddal)

31. Long-Term Capacity-Building Strategy Through Sub-Regional Networking and Projects: the IOC (UNESCO)/FER (EU) Pilot Project for Latin America and the Caribbean; (IOC)

ANNEX IV

REPORT ON C-GOOS STAKEHOLDER'S WORKSHOP (OCTOBER 29, 1998)

1. OPENING REMARKS

At the beginning of the workshop, speeches of welcome were given by Dr. Nicolau Klüppel (the representative of the Governor of the State of Parana), Dr. Waldomiro Gremski (representative of the President of the Federal University of Parana - UFDP), Vice-Admiral Marcos Augusto Leal de Azevedo (Director of the Diretoria de Hidrografia e Navegaçâo (DHN)), Dr. Carlos Garcia (President of the University of Rio Grande), and Dr. Carlos Soares [Vice-Director of the Centre of Marine Studies (CMS) of the Federal University of Parana]. Each speaker explained their own close involvement in different aspects of basic and applied marine science on the coast of Brazil, and pointed out how important programmes like C-GOOS are for countries like Brazil. It can contribute to the navigation safety of the Brazilian coast, promote the economy in Brazil by making the ports more attractive to foreign ships, enhance collaboration with other nations and foster the scientific development of Oceanography in Brazil.

On behalf of the IOC of UNESCO, and of the other sponsors of GOOS (WMO, UNEP and ICSU), Colin Summerhayes, Director of the GOOS Project office in the IOC, welcomed participants to the C-GOOS workshop, and thanked the distinguished guests for their warm and generous welcome and for their hospitality in welcoming C-GOOS to Curitiba, a city famous for its environmental initiatives. He remarked that it was fitting that we were meeting in Brazil, which is already an important player in GOOS at the international level through its leadership of the PIRATA project in the tropical Atlantic, and its secondment of key staff to the GOOS Project Office in Paris. Brazil is setting a fine example to other countries in South America in developing a national contribution to a major international programme, which, like the WMO's World Weather Watch will serve the entire global community.

He noted this particular meeting is an important departure for GOOS in two ways: (I) being the first meeting between C-GOOS and the user community, and (ii) being the first international GOOS meeting in South America. It is vital that GOOS planners meet, talk with and ascertain the needs of the user community, since GOOS must be designed to meet societal as well as scientific needs. He thanked people for giving up their valuable time to attend the meeting, and looked forward to an informative dialogue that would help the Panel of C-GOOS to design an observing system that would produce products and services that people needed to manage the marine environment in a sustainable way and to protect themselves from its dangers.

Colin Summerhayes then gave a presentation on GOOS, following which Tom Malone gave a presentation on C-GOOS.

2. SOCIAL AND ECONOMICAL NEEDS: THE STAKEHOLDER'S PERSPECTIVE

2.1 COASTAL ZONE MANAGEMENT

Paulo Castella, from the Office of the Secretary for the Environment, presented the Coastal Zone Management Programme created for the Brazilian coast in 1981 and improved in 1988. The goals of this Programme are to plan coastal development, to mediate conflicts in coastal areas and to benefit society, economy and the environment. All states in Brazil participate in this Programme. Individual states execute the research/monitoring and write the environmental quality reports. Polluters are fined according to the established laws.

The waters of Paranaguá Bay are being monitored for dissolved oxygen, coliform bacteria, metals in the sediment and water column, pH, and total suspended solids. The first three parameters are especially important for the intensive aquaculture efforts in Paranaguá Bay. The data are usually summarized in the form of written reports but efforts are being made to also summarize them electronically. In addition, the social-economical impacts of coastal development are starting to be pursued.

2.2 HARBOR MANAGEMENT

Dr. Luiz Ivan de Vasconcellos, Technical Director of the Port of Paranaguá, gave a presentation on the work being carried out to improve navigation and environmental conditions in the Port of Paranaguá. The Harbour authorities are working in partnership with other organisations, including the Brazilian Navy's DHN, and the University's CMS, to collect wind, wave and sea-level data to help improve navigation, and to monitor changes to the local ecology caused by such activities as the discharge of ballast water, and the dredging of navigation channels. The partnership has led to the choice of more suitable locations for the disposal of dredge spoil, better definition of the dredged channels, shifts in channel position to reduce its rate of siltation, thereby saving on dredging costs, and sound advice on the best time of year to dredge so as to avoid environmental damage.

Having found that the data and their analyses can be useful in planning of the modernization and expansion of the port so that the environment is kept clean, the port authorities believe that a technical advisory group is needed to keep navigation safe while preserving the environment. This could be accomplished through collaborations with the Navy and universities which could aid in the establishment of shipping regulations, implementation of nautical signs, monitoring of environmental conditions, development of models, collection of bathymetry data and addressing environmental concerns. As a result the costs of the port operation would decrease, the port would be open for more days in the year (making it more competitive), safety would increase and expansion of the port would be done in healthy way.

The port authorities are also collaborating with the Brazilian petroleum company (Petrobras) to develop regulations on oil spills.

2.3 THE TRAIN-SEA-COAST COURSE

Prof. Carlos Soares of the CMS explained the Train-Sea-Coast Programme, which includes another 10 centres worldwide. In Brazil it is run mainly by the University of Rio Grande do Sul. The programme, which is centred on a 2-week long course funded by the UN's Law of the Sea programme, aims to educate people from environmental agencies along with non-scientific users, such as legislators, industrialists and environmental managers, about the science and requirements of Integrated Coastal Area Management (ICAM).

Recently, the Federal University of Parana, supported by the Brazilian government, offered a Train-Sea-Coast Course to train people within government and environmental agencies in coastal ecological problems. Preparation for this course involved several phases: problem analysis, job analysis, population analysis, the design of the curriculum, the design of locally important modules, production of materials, implementation, and evaluation. The problem analysis involved the selection of a relevant topic for the coast of Parana; the job and population analysis identified the group which could most benefit from this course; the design of the curriculum focussed on the most relevant issues for the area. Once these tasks were completed, the materials needed to be printed, the course implemented and then evaluated.

Problems identified during this course included the following:

(a) the course was relatively costly to produce, and required a high registration fee (US$300-350). If employers do not cover these costs, many individuals cannot afford to participate;

(b) long-term funding for this activity is not certain;

(c) because the course is relatively long (two weeks), people like the lawyers and consultants for whom it is designed in part may not be able to attend, so the course may not be reaching a certain audience;

(d) there is not a uniform interest among potential sponsors (government, local government and industry) in raising environmental awareness.

2.4 MARINE SCIENCE POLICY IN BRAZIL

Marilia Albuquerque of the Ministry for Science and Technology, MCT, explained that the mission of the Ministry is to promote scientific and technological development and to execute research necessary for social, economical and cultural progress of Brazil. The present science and technology system was implemented in 1985. Mrs. Albuquerque discussed the different components and explained how they are interlinked. Three universities offer BS degrees in Oceanography: Rio de Janeiro, Itajai (Santa Catarina), and Rio Grande (Rio Grande do Sul). Three universities also offer graduate degrees: Sao Paulo, Rio Grande, and Pernambuco. In addition, the government supports institutions for Oceanographic and Limnological research like the Instituto de Pesquisas da Amazonia.

3. OPERATIONAL OCEANOGRAPHY: STATE OF THE ART IN SOUTH AMERICA

3.1 GOOS BRAZIL

Dr. Dieter Muehe addressed the coastal module of GOOS in Brazil. C-GOOS should gather data that can be used to support decisions regarding coastal development and the use of natural resources in coastal areas. For example, the risk of coastal erosion has been estimated for an area ranging from Cabo Frio in Brazil to Peninsula Valdez in Argentina (within Brazil the focus is between Cabo Frio and Chui). More data are still needed in certain areas in order to provide a better product (for example: discharge data in the region of Cabo Frio). Hopefully these data will save lives as well as the natural environment.

3.2 THE PROSPECTS OF REGIONAL COASTAL GOOS PILOT PROJECTS IN SOUTH AMERICA

Ilana Wainer discussed possible South American activities within C-GOOS. A South American network of monitoring sites and buoys has been suggested. For success the project needs compatible data; funds to maintain equipment; data analysis and dissemination; and human resources.

3.3 THE FUTURE OF C-GOOS IN SOUTH AMERICA

Eduardo Marone summarized the results of the workshop reported on in Annex VII, which called for mutual strengthening of capabilities for the establishment of a regional natural hazard warning system in South America under the GOOS umbrella.

3.4 DISASTER PREVENTION

Consuelo Barrera, of the Colombian Direcion Nacional para la Prevencion y Atencion de Desastres, explained the creation of a disaster warning and relief programme in response to storms and mud-slides causing catastrophic loss of life and crops in Columbia. The programme comprises a network of individuals from the smallest villages to the federal government. Individual observations are passed to local offices, thence to regional offices, and thence to the National Centre for Prevention and Attention of Disasters. This agency provides warnings, manages rescues, and coordinates the distribution of assistance when and where needed.

3.5 ANALYSIS OF THE RISK OF COASTAL EROSION INDUCED BY EPISODIC STORMS FROM CABO FRÍO (BRAZIL) TO PENÍNSULA VALDÉS (ARGENTINA)

Federico Ignacio Isla, from the Universidad Nacional de Mar del Plata, Argentina, presented the status of the efforts to study the links between erosional problems and coastal dynamics. Notwithstanding similar sea-level histories on the coastal plains and barriers of Brazil, Uruguay and Argentina, present beaches are today subject to severe erosion rates induced by storms coming from the south and south-east. In addition, studies of sea-level along the southeastern coast of South America demonstrate that it responds strongly to changes in rainfall that are driven by El Niño events.

The Regional Group of the OSNLR Project (Ocean Science related to Non-Living Resources) of the IOC proposed to study the effects and recurrence of these episodic phenomena. Objectives comprise: the analysis of tidal and meteorological time series, the measurement of morphodynamic changes, the co-ordination of the consulting scientific availability, the proposal of environmental regulations for the coastal zone, the construction of risk maps, and the organisation of training courses. The results would "overflow" to other international programs (LOICZ, IGCP 367, IPCC, INQUA).

From 1988 to 1994, Argentina, Brasil and Uruguay have been involved in an OSNLR Project for the South West Atlantic Ocean. This program has been supervised by a joint regional program for the 3 countries ("Atlántico Sud Occidental Superior", ASOS). The first product of this project is a series of sedimentological and bathymetric maps of the platform shelf, with morphological reference to the coastal plain (Martins and Correa, 1996).

This project was originally proposed during the Montevideo ASOS meeting (1994) and confirmed in the next meeting (Mar del Plata, 1995). The co-ordination of this project was already established with research groups from the universities of Rio de Janeiro (UERJ), Sao Paulo (USP), Curitiba (UFPR), Itajaí (UNIVALI), Florianopolis (UFSC), Porto Alegre (UFRGS), Rio Grande (FURG), Montevideo (UR, SOHMA), Buenos Aires (UBA, SHN), La Plata (UNLP), Mar del Plata (UNMDP) and Bahía Blanca (UNS).

3.6 STORM SURGE FORECAST SYSTEM FOR THE SOUTH-WESTERN ATLANTIC OCEAN

Ricardo de Camargo, from the Department of Atmospheric Sciences of University of Sao Paulo (IAG-USP), presented the results of work on storm surge numerical modelling for the region. Storm surges over the Atlantic coast of South America have important effects in terms of coastal erosion, sediment dynamics and harbor activities, among others. The aim of the project is to present a numerical system for storm surge forecasts in the South-Western Atlantic Ocean, basically for the northern Argentinean and Uruguayan shelves and the South Brazil Bight shelf, hereafter called SWAO region. The system will be able to provide information on disturbances in the surface elevation and shelf current fields related to the passage of meteorological systems over the studied area. It is very important to mention the cyclogenetic characteristics of the region of interest, which play an important role in storm surge events.

Mesoscale meteorological forecasts for the study area can be supplied by operational runs of the Regional Atmospheric Modelling System (RAMS) at the Department of Atmospheric Sciences of University of Sao Paulo. The model assimilates large scale analysed and predicted fields provided by global models (normally NCEP and CPTEC, and occasionally ECMWF) and improves the forecast considering regional aspects in a 32km grid.

The oceanic part of the system is based on the Princeton Ocean Model (POM) simulations for the SWAO area with approximately 10km resolution, forced by predicted wind fields provided by RAMS as described above. The use of mesoscale wind fields in previous hindcasting simulations shows better results in comparison to wind fields taken directly from global models.

ANNEX V

PROPOSAL FOR A GLOBAL COASTAL MONITORING SYSTEM

Preamble

This background paper and its four attachments describe an attempt in 1990-1991, long before the Coastal Workshop in Miami in February 1997, by the IOC-UNEP-WMO community, to develop a global coastal monitoring system as part of GOOS. The attachments are provided to help to ensure continuity in the development of Coastal GOOS. Although the proposals described in the attachments are 'old', much of what they suggest is still valid and may be useful in developing the design for Coastal GOOS implementation and pilot projects.

Attachments

A. IOC, 1990, Proposal on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena related to Climate Change. Annex III to UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change, Paris, December 10-14, 1990, UNEP-IOC-WMO/GCNSMS-I/3, 17pp.

B. IOC, 1990, A Description and Physical oceanographic rational for IOC/WMO/UNEP Long-term Monitoring System for Coastal and Near-Shore Areas. Information Document UNEP-IOC-WMO/GCNSMS-I/Inf.2, 17pp (presented at UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change, Paris, December 10-14, 1990).

C. IOC, 1991, Action Plan for the Implementation of Pilot Phase Activities of the Long-Term Global Monitoring System of Coastal and near-Shore Phenomena related to Climate Change. Annex III to UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change, Pilot Projects on Mangroves and Coral Reefs, Monaco, December 9-13, 1991, UNEP-IOC-WMO-IUCN/GCNSMS-II/3, 19pp.

D. IOC, 1993, Proposed Pilot Programme for a Coastal Circulation Component of the Global Ocean Observing System. Tabled at First session of I-GOOS, Paris, February 1993 (IOC/GOOS-I/Inf.3, 14pp).

Historical Background Summary

The History, below, helps to explain why it took so long to develop the coastal dimension of GOOS. Clearly there was a lot of initial enthusiasm for developing Coastal GOOS, which it was thought could initially be implemented through six pilot projects on:

- sealevel change and coastal flooding.
- coastal circulation.
- assessment of organic carbon accumulation in surface coastal sediments.
- changes in plankton community structure.
- benthic communities: coral reef ecosystems.
- terrestrial vegetation: mangrove communities.

However, at that time (1990-1991) the programme was ambitious and there was not enough budget or staff to support all of it. Of the six pilot projects, the sea-level one has been partially dealt with by GLOSS, but continues in the storm surge proposal that is part of the background papers for the Curitiba meeting; the coastal circulation one has been partly dealt with by WESTPAC; the carbon one has disappeared; the plankton one takes the form of IOC's investment in the Continuous Plankton Recorder programme, and is under consideration by the LMR Panel; the coral reef one has come to fruition in the form of the Global Coral Reef Monitoring Network; and the mangrove one is being handled elsewhere (ie outside IOC and not in GOOS).

The historical analysis also indicates that the initial Coastal group was not preserved when the I-GOOS and J-GOOS committee structure for GOOS was developed in 1992-93, which meant that the key players left the scene. The impetus was lost until an *ad hoc* Coastal Panel was formed by J-GOOS in April 1995, the delay reflecting inadequacies in the communication between I-GOOS (which had recommended in 1993 that such a panel be formed, J-GOOS, which should have acted on the request, and the GOOS Support Office, which should have provided J-GOOS with the appropriate documentation and forced the issue). The work of the *ad hoc*

Coastal Panel culminated in the Miami Workshop in February 1997, following which staff and financial resources were finally found to meet the requirements of an established Coastal Panel.

History of Development of Coastal GOOS Prior to Miami Coastal Workshop

Following an initial proposal made by UNEP in October 1989, the Secretariats of IOC, UNEP and WMO, decided it would be necessary to develop a long-term global monitoring system for coastal and near-shore zone observations, including physical and biological parameters, to provide data on global changes with special reference to those associated with or attributable to the impacts of suspected climate change.

In March 1990, the 23rd IOC Executive Council approved the preparation that the Secretariats proposed of a Master Plan for a Global Coastal Zone Observing System, and required that it be developed in close harmony with the other activities being undertaken by the IOC Technical Committee on Ocean Processes and Climate (C/OPC) to develop long term systematic ocean observations for monitoring and predicting environmental changes, including the formulation by the OOSDP (Ocean Observing System Development Panel) of the conceptual design of an operational observing system for monitoring physical and other properties that determine the ocean circulation, the response of the ocean to climate change and the initial-value inputs for climate predictions. The Master Plan was to be developed by two consultants, one for physical and one for biological parameters and to be presented by July 1990 (ref. = IOC/EC-XXIII/8 Annex 1 addendum). The consultants were expected to make a large number of country visits to consult different coastal establishments in the process of drawing up the plan.

In July 1990, the Consultants presented to the Secretariats of IOC, UNEP and WMO the Framework Master Plan for a Global Coastal Monitoring System. This document was considered to be the first draft of a proposal for a Long-Term Global Monitoring System of Coastal and Near-Shore Phenomen Related to Climate Change (GCNSMS). I t was reviewed and revised at an inter-Secretariat meeting in Geneva in July 1990, and the revised version was circulated for review to a number of scientists and agencies.

A UNEP-IOC-WMO Group of Experts was formed to review the proposal for the GCNSMS, and met in December 1990. Among other things it aimed to consider the establishment of a programme of coastal zone research and monitoring in order to identify effects of climate changes on the coast and coastal ecosystems, and to assess the vulnerability of various natural and managed ecosystems such as coral reefs, mangroves and coastal agriculture. The meeting led to a further revision of the proposal, presented as Annex III to the report of the meeting (UNEP-IOC-WMO/GCNSMS-I/3), attached here as Attachment A. One of the background documents to Annex III (UNEP-IOC-WMO/GCNSMS-I/Inf.2) describes a physical oceanographic monitoring component of a GCNSMS (Attachment B).

The proposal recommended the adoption of pilot studies on:

- sea-level change and coastal flooding.
- coastal circulation.
- assessment of organic carbon accumulation in surface coastal sediments.
- changes in plankton community structure.
- benthic communities: coral reef ecosystems.
- terrestrial vegetation: mangrove communities.

The meeting recommended that the proposal be brought to the attention of the governing bodies of the three sponsors with a request that they endorse the concept and objectives and advise on its implementation.

The proposal was considered and endorsed by the 4th session of C/OPC in February 1991, which recommended that the GCNSMS should be developed in conjunction with the development of GOOS, that coastal ocean monitoring should be planned and developed within the framework of GOOS, and that the Secretary of IOC should initiate the proposed pilot projects as appropriate.

In March 1991, the 16th IOC Assembly considered reports on both GOOS and the proposed GCNSMS. The Assembly decided (Resolution XVI-8) to undertake development of a Global Ocean Observing System (GOOS), built initially on esisting systems and operated by Member States for the needs and benefits of each. GOOS was seen as including as "modules" or "subsystems" of the overall system elements such as:

(i) climate observations,
(ii) marine pollution monitoring,
(iii) coastal zone monitoring, and
(iv) regional programmes.

The Assembly expressed strong support for the proposed GCNSMS, endorsed its concept and objectives and adopted the recommendation of the C/OPC to implement the proposed pilot studies, recommending the implementation of these through IOC regional bodies and task teams (Resolution XVI-10) as a contribution to GOOS.

In December 1991, an *ad hoc* Expert Group chaired by Geoff Holland formulated a Draft GOOS Development Plan (IOC/EC-XXV/8 Annex 1), which described the GOOS objectives and basic concept, and the five GOOS modules, including:

- climate monitoring assessment and prediction.
- monitoring and assessment of marine living resources.
- coastal zone management and development.
- assessment and prediction of the health of the ocean.
- marine meteorological and oceanographic services.

The IOC-UNEP-WMO Expert Group on a GCNSMS also met in December 1991, to consider how to take forward two of the six recommended pilot studies, namely those on coral reefs and mangroves. By this time the sponsoring group had been expanded to include the IUCN (World Conservation Union). An Action Plan for the implementation of pilot phase activities of the coastal system that was presented in Annex III of the report of the meeting (UNEP-IOC-WMO-IUCN/GCNSMS-II/3) covers these two pilot study areas (see Attachment C). The meeting recommended that the governing bodies be requested to support the development of the pilot phases, in particular these two.

The final, 5th session of the C/OPC, in March 1992, recommended to the 25th IOC Executive Council that IOC:

(i) establish a new IOC Committee to serve as the intergovernmental forum for promoting GOOS (I-GOOS),
(ii) establish a Scientific and Technical Advisory Panel to advise that committee (J-GOOS) (Recommendation OPC-V.4), and
(iii) include the GCNSMS pilot activities within the framework of the GOOS module on coastal zone management.

The C/OPC noted that if there were insufficient resources to implement all the coastal pilot studies simultaneously, their implementation should be phased in accordance with the interests of the Member States. They further invited GLOSS to take on the implementation of the sea level pilot activity.

Later in March 1992, the 25th IOC Executive Council recognised that GOOS would be coastal as well as global and multidisciplinary in nature, endorsed the recommendations of the C/OPC, and specified that the group of experts on GLOSS should be a subsidiary body of the new Committee (I-GOOS), thereby incorporating sea-level measurements in GOOS. The Executive Council endorsed the proposals of the Group of Experts on the GCNSMS for six pilot phase activities and agreed with the recommendation to proceed first with the coral reef and mangrove activities. In addition the EC listed as an initial task for J-GOOS: to "consider the establishment of a scientific and technical subgroup to define the rationale, criteria, scope and initial elements of the coastal module of GOOS" (Resolution EX-XXV-3, Annex 2).

To take forward the development of the sealevel pilot activity, an *ad hoc* Meeting of Experts on the IOC-UNEP-WMO Pilot Activity on Sea-Level Change and Associated Coastal Impacts was held in Paris in October 1992 (see report in Annex VIII of the Report of the 3rd session of GLOSS). A draft action plan for the sea-level activity was presented by a consultant (IOC/INF-908), and followed up at a UNEP-IOC Workshop on Impacts of Sea Level Rise, in November 1992 and by the third session of the IOC Regional Committee for the western Indian Ocean in December 1992. It was agreed that the activity should focus on the coastal zones in the Indian Ocean, and that the project should be adopted by GLOSS. Pilot phase activities for 1993-96 included:

(i) storm surges in the Bay of Bengal;
(ii) sea-level variability in the Maldives Archipelago and adjacent areas;
(iii) sea-level variations and their impact on coastal erosion in the western Indian Ocean.

To take forward the development of the coastal circulation pilot activity a consultant was requested in 1992 to develop a proposal for a Pilot Programme for a Coastal Circulation Component of the Global Ocean Observing System (Attachment D) (ref: IOC/GOOS-I/Inf.3). The proposal focussed on a pilot activity in the western Pacific region, focussing on the East China Sea, and was submitted to the second session of the IOC Subcommission forWESTPAC (January 1993). WESTPAC officers were asked to take action on the activity following I-GOOS-I in February 1993. A WESTPAC programme on Continental Shelf Circulation was created and plans were made for (i) a training workshop on numerical modelling, and (ii) a joint China-Philippines cruise in the Sulu Sea.

The first I-GOOS meeting took place on 16-19 February 1993, where progress with the six pilot activities for the GCNSMS was reviewed:

1. sea-level change and coastal flooding: being taken forward by GLOSS (see report above for October 1992).

2. coastal circulation: being taken forward by WESTPAC (see above paragraph).

3. assessment of organic carbon accumulation in sediments: no plans were prepared due to uncertainty about (i) the methodology for organic carbon analyses, (ii) the selection of sites, and (iii) limited resources.

4. changes in plankton community structure: a draft plan for monitoring plankton community structure by Continuous Plankton Recorder had been developed by a consultant (IOC/GOOS-I.Inf.2); this was now considered to be the province of the LMR Panel.

5. benthic communities: coral reef ecosystems: an action plan had been prepared, and the UNEP-IOC Global Task Team on the Implications of Climate Change on Coral Reefs had agreed to act as an expert advisory body for this project.

6. terrestrial vegetation: mangrove communities: an action plan had been prepared, and the UNEP-UNESCO Task Team on the Impact of Expected Climatic Change on Mangroves had agreed to advise on the design of this project.

I-GOOS-I (Feb. 1993) also agreed that:

(i) a Coastal Panel should be established,
(ii) high priority should be assigned to the development of the GOOS Coastal Module,
(iii) J-GOOS be invited to review the pilot activities and provide advice on their implementation.

The IOC Assembly in February-March 1993 recieved reports on the GCNSMS pilot activities. It agreed that these pilot activities were important (while noting that sufficient funds had not been designated for their implementation), and that a Coastal Panel should be established.

The first planning session of I-GOOS, in April 1994, recommended that an *ad hoc* panel be established for the coastal module, to prepare an outline strategic plan.

Unfortunately, no documentation on the work of the Group of Experts on the GCNSMS or on progress with the six pilot activities was supplied by the GOOS Support Office to the first meeting of J-GOOS (May 1994), which meant that the efforts of the Group of Experts on the GCNSMS were put aside and continuity was lost. J-GOOS-1 asked a group of its members to draft a proposal for an *ad hoc* J-GOOS group on the scientific components of a coastal zone module for further consideration at J-GOOS-II (in 1995).

At the fourth session of GLOSS, in January-February 1995, a report was given on the status of the pilot monitoring activity on sealevel changes and associated coastal impacts in the Indian Ocean, the objectives of which were:

(i) improve understanding of the processes that control sea level variability at sites where sea-level is monitored in the Indian Ocean;

(ii) enhance capabilities of countries of the Indian Ocean to monitor and analyze sea level data.

The project had set up a network of Cells for Monitoring and Analysis of Sea-level (CMAS) in eight countries. CMAS scientists had met at a workshop in January 1994, where it had been decided that enhancing the expertise available was a major priority. Training to meet this requirement was planned for late 1995.

Because there had been no significant response by J-GOOS to I-GOOS's call for creation of a Coastal Panel, in April 1995 the I-GOOS strategy subcommittee recommended that J-GOOS establish a coastal module panel as a matter of priority. At the J-GOOS-II meeting late in April 1995 it was decided to establish an *ad hoc* panel to define the scientific and technical components of the GOOS Coastal Module. The *ad hoc* panel was asked to prepare a first draft response to this call, and to hold a workshop before March 1997. J-GOOS was informed about the collection of pilot activities established within the framework of the UNEP-IOC-WMO GCNSMS, but only four activities were listed (reefs, mangroves, sealevel and plankton). The report of J-GOOS-II shows that at that time the six pilot activities were not being incorporated into the GOOS design.

At the second session of I-GOOS (I-GOOS-2; June 1995) progress with the proposed GCNSMS pilot activities was reviewed:

1. Pilot Activity on Sea-level Changes and Associated Coastal Impacts in the Indian Ocean: GLOSS activity.

2. Pilot Activity on Coastal Circulation: WESTPAC activity.

3. Pilot Activity on Organic Carbon Accumulation: Defunct.

4. Pilot Activity on Monitoring Plankton Community Structure: Considered to be the responsibility of the LMR-GOOS Panel, with support provided by the IOC for the implementation of the Continuous Plankton Recorder (CPR) survey being carried out by the Sir Alastair Hardy Foundation for Ocean Science (SAHFOS).

5. Pilot Activity on Monitoring Coral Reef Ecosystems: The progress and future development of this activity had been considered by the IOC-IUCN-LOICZ Expert Meeting on Coral Reef Monitoring, Research and Management, in Bermuda in October 1994. The expert meeting recommended development of a Global Coral Reef Monitoring Network (GCRMN) as part of the GOOS Coastal Module.

6. Pilot Activity on Monitoring Mangrove Communities: I-GOOS-II (June 1995) noted that a UNEP-UNESCP Task Team on the Impact of Expected Change on Mangroves, had prepared under the "Assessment and Monitoring of Climate Change Impacts on Mangrove Ecosystems" published by UNEP in 1994, and had invited the J-GOOS Coastal Panel to advise on implementation of this pilot activity.

Subsequently, at the 18th IOC Assembly, in June 1995, there was no significant discussion on the coastal module of GOOS, or of the six pilot activities, apart from recognition that the GCRMN had the potential to be a significant component of the GOOS Coastal module (as acknowledged by I-GOOS-II). At the Assembly the IOC decided to support the establishment of the GCRMN and the appointment of a Coordinator. In addition, the IOC formally began involvement in coastal zone activities, emphasizing that these represent a new development for IOC as well as a major trend in the development of future IOC activities. However, discussions of Integrated Coastal Area Management (ICAM) were not linked to coastal GOOS.

In February - March, 1996, WESTPAC's third session noted that the coastal circulation pilot activities were not being pursued separately, but were effectively subsumed within the NEAR-GOOS pilot project, and the Gulf of Thailand Project.

At J-GOOS-III (April 1996), progress in developing a Coastal Workshop was described, and a strawman proposal for Coastal GOOS was presented. A key, over-arching objective was seen as providing a basis in models and observations for extended predictability in the coastal environment. J-GOOS-III did not discuss the six pilot activities.

The *ad hoc* J-GOOS coastal panel organised a coastal module planning workshop which took place in Miami in February 1997; the report was subsequently published.

J-GOOS-IV, which met in April 1997, discussed the report of the Coastal Workshop and recommended formation of a Coastal Panel (as opposed to an *ad hoc* group), which was duly endorsed by I-GOOS-III in June 1997; the new Panel held its first meeting in April-March 1998. It did not consider the list of six pilot activities, but did consider progress with reefs and mangroves.

The latest initiatives under the heading of pilot activities proposed by the Expert Group on the GCNSMS appear to be as follows:

(i) *Sea-Level*: a the storm surge proposal has been developed by the IOC and WMO for presentation to the 1998 Executive Council, and tabled for discussion at the Curitiba meeting of C-GOOS.

(iii) *Plankton*: incorporation of the CPR into LMR-GOOS is still under consideration; meanwhile, IOC continues to part-fund the SAHFOS CPR programme.

(iv) *Reefs*: The GCRMN was duly set up, and its strategic plan was published in 1997. A resumee of activity is given in the Miami Coastal Workshop report. Essentially the project is moving along under the aegis of the GCRMN.

(v) *Mangroves*: No further action is recorded by I-GOOS or J-GOOS, apart from a resumee of activity. C-GOOS may wish to consider how this topic should be taken forward.

ANNEX VI

DEVELOPING FUNCTIONAL LINKAGES AMONG SCIENTISTS AND USERS

"Restricting the body of knowledge to a small group deadens the philosophical spirit and leads to spiritual poverty." - Albert Einstein

Coasts and oceans are dynamic places containing complex, interrelated ecosystems. Although our understanding of these systems and the physical, chemical, and biological processes that drive them is continually advancing, there are still large gaps in our knowledge. This is especially true with regard to the detailed understanding generally needed to support informed management decisions in coastal areas.

The challenge is to focus more scientific attention on management-related research and monitoring questions. Scientists, from their side, claim that users do not convey their research and monitoring needs clearly and effectively, and furthermore, that they do not appear to use the research and monitoring results that already exist. On the other hand, resource managers claim that scientists are often not interested in the applied science that they require and that they often don't listen to the needs of the users or requests for relevant information. Coastal GOOS is an opportunity to create a process that promotes functional linkages among scientific and user groups.

1. ORGANIZING A PROCESS FOR STAKEHOLDER PARTICIPATION

There are two critical parts of organizing a process for diverse stakeholder participation. The first is, given the multiple interests involved in coastal management, the process must be an interactive one involving scientists, decision makers, and other "stakeholders." Who should participate in the process, i.e., "who will sit at the table?" How will the participants be chosen, by whom, and what form will their participation take? The second is, how can the participation of the stakeholders be maintained over time, particularly those who "represent" the public and who are unpaid volunteers, unlike salaried representatives of private sector interests?

Who participates? Given the multiple interests in coastal management in all contexts, a basic principle is that decisions to undertake and finance specific actions for coastal management, including research and monitoring, are not likely to be made and carried out unless all "parties at interest" or "stakeholders" have been involved in the process. The stakeholders include:

(i) representatives of government agencies at all levels (national, regional, local), because they have responsibilities for certain relevant management tasks, and often for various policies that affect management actions, including research and monitoring;

(ii) major economic interest groups, e.g., commercial, industrial, agricultural, tourism, where representation could be by an individual from a single enterprise, or by an individual chosen by an organized group, e.g., industrial association, association of tourism operators, or association of developers;

* representatives of the scientific or academic community;

(iii) environmental non-governmental organizations (NGO's), e.g., World Wildlife Fund, the International Union for the Conservation of Nature, The Nature Conservancy;

(iv) community groups or NGO's other than environmental groups, e.g., civic associations, that might be considered to represent "the public," e.g., the League of Women Voters;

* representatives of indigenous and /or subsistence user groups; and

(v) professionals knowledgeable about the substantive aspects of coastal management, who are not attached to any of the above interest groups or to the designated coastal management agency.

Style of Participation. "Participation" is a word that rolls easily off the tongue, but rarely is defined in operational terms. Just what is involved in "participation"? What do individuals and groups actually do when they are "participating"? One typical form of participation is the establishment of committees or task forces, to carry out specific assignments and report to some governing institution. For example, a committee could be assigned the task of identifying monitoring needs for the evaluation of the performance of management strategies related to a particular issue, e.g., land-based sources of marine degradation. Generally the committees consist solely of volunteers, who are provided with neither staff nor compensation to undertake any independent data collection or analysis. What a committee accomplishes depends on the degree of specificity in its charge, on the willingness of committee members to spend time on substantive work, and on the professional capabilities of committee members.

A second form of participation is to use a committee of stakeholders as a "sounding board," i.e., to react to, and make suggestions about, the analyses and proposals put forth by a responsible technical group, e.g., the Coastal GOOS Panel. This can be a useful procedure, particularly if users are included on the committee and if interaction takes place frequently so that the committee actually understands what is involved in the proposals of the panel, in all their complexity, and what is presented to it.

How to Ensure Participation over Time? Experience with participation by stakeholders in natural resources management decisions over the last 25-30 years has typically been in relation to "one-shot" planning efforts. That is, the planning effort has been for some finite period of time, e.g., 2-3 years, at the end of which a specific action programme was to be produced for consideration in the decision process. The stakeholders were involved as an advisory group or several advisory groups, to interact with, and contribute to, both the scientists and the decision-makers. Often the individuals or institutions that actually were day-to-day managers of the resource typically were not involved, or were involved only peripherally. At the end of the specified time period, a report with recommendations was formally submitted to the decision process. After the decision was made, stakeholder participation in the planning process essentially ended, because no mechanism for continuous or adaptive management and associated stakeholder participation had been established.

Therefore, the most difficult part of "stakeholder participation" is institutionalizing participation over time, as an integral part of adaptive coastal management, in contrast to participation in "one-shot" efforts. It is relatively simple for private sector groups to provide for continued participation. Industrial firms, tourist industry groups, consulting firms, chambers of commerce, can assign and finance participation of representatives. In some cases, environmental and other NGO groups with full-time staffs can allocate resources to participate. It is considerably more difficult for citizen advisory groups or indigenous representatives to sustain continuing representation. Options to finance such participation should be considered in the design of the Coastal GOOS strategic planning process.

Even if stakeholder capacity to participate could be organized and financed, the process of participation must be developed jointly by whatever institution is responsible for research and monitoring and the stakeholders, and then implemented. This means that resources must be allocated for this activity. If interest of the stakeholders is to be maintained, and useful contributions obtained from them over time, participation must be truly substantive, interactive, and collaborative. For example, stakeholders could be involved in: (1) the development and review of monitoring systems relating to performance of coastal management activities; (2) the development of, and review of results from, research and monitoring programmes, or communication of continuing perceptions of coastal management problems and of priorities for actions; (3) development of alternatives for financing research and monitoring activities over time. In effect, the stakeholder "committee" would be conceived of, and used as, a continuing "sounding board."

2. THE CULTURES OF SCIENCE AND ITS USERS

One of the problems, of course, has to do with the different cultures to which scientists and the users of their information belong. Scientists and users are often worlds apart in their value systems and their ways of looking at the world. Table 1, modified from a 1995 report of the U.S. National Research Council, illustrates these differences:

2.1 BEHAVIOURS AND POINTS OF VIEW TYPICALLY ASSOCIATED WITH THE CULTURES OF SCIENCE AND USERS

Factor
Science
Users
Valued action
Research, scholarship
Decisions, results
Time frame
Whatever needed to gather evidence
Immediate, short-term
Goal

Increase understanding
Manage immediate problems
Basis for decisions
Scientific evidence
Science, values, public opinion, economics
Expectations
Understanding is never complete
Expect clear answers from science
Grain
Focus on details, contradictions
Focus on broad outline
World view
Primacy of biological, physical, chemical mechanisms
Primacy of political, social, interpersonal, economic mechanisms

Source: 1995, National Research Council, Science, Policy, and the Coast: Improving Decision making, 85 p.

2.2 OBSTACLES ARISING FROM CULTURAL DIFFERENCES

The cultural differences between science and users pose a number of problems or obstacles in relationships between coastal scientists and users: (1) lack of understanding; (2) lack of communication; (3) lack of, or misuse of, each other's products; and (4) conflict and competition instead of cooperation.

(i) Lack of Understanding. As the NRC states, "Human ego is a powerful thing, and few things offend us and make us react in negative ways as much as the knowledge that another person does not value, respect, or understand what we are as individuals or what we do professionally." Unfortunately, all too often in debates about coastal decision making one sees natural and social scientists, fishermen, environmentalists, private property advocates, and policy makers dealing with one another without mutual respect for perspectives and positions. Understanding, as the NRC report points out, "doesn't have to mean admiration or agreement, but simply an acceptance of the fact that the other party has a legitimate status and role in the human ecology of the policy making process and views that must be understood in the context of that status and role."

(ii) Lack of Communication. "Cultural differences, whether they stem from language, occupation, or advocacy position, tend to make communication more difficult. Not only are we less likely to communicate at all with different cultures and subcultures, but communication that does occur tends to be fraught with misinterpretation or lack of understanding. This frequently happens in discourses between scientists, managers, and other stakeholders. Even though they may all be speaking at the same public hearing or meeting, there is all too often very little real communication taking place.

(iii) Lack or Misuse of Each Other's Products. As the NRC report notes, "It is often the case that an administrator will not know how to use the contents of a scientific report. It is often the case that a scientist will not understand the genesis or rationale for a particular public decision-making process. Private citizens will often be confused by both a scientific report and the decision making process. The unfortunate response is for individuals to disengage - that is, to withdraw from the interaction or process - or simply to ignore the activity or viewpoint of others."

(iv) Conflict and Competition Instead of Cooperation. As noted in the NRC report, "All of the above effects lead to conflict and competition in place of cooperation. They are all dimensions of the potentially negative public policy outcomes that can result from cultural differences, when those differences are not recognized, understood, and addressed.

3. WAYS TO IMPROVE SCIENTIST-USER INTERACTIONS

Some ways to improve scientist-user interactions are noted in the NRC report: (1) improve mechanisms between scientists and coastal users; (2) enhance communications among scientists and coastal users; (3) build capacity for scientist-user interactions; and (4) employ integrated and adaptive approaches in coastal management; and (5) deploy resources to support these objectives.

(i) Improve Mechanisms for Interaction between Scientists and Users. The fundamental point here is that if there are no established fora or regular mechanisms for interaction between scientists and users, few, if any, interactions will occur. A variety of methods through which scientists and users can interact are cited in the NRC report: (1) scientific advice can be provided internally within agencies, i.e., management agencies hire scientists to advise them in coastal decision making; (2) advisory groups external to agencies can be created such as scientific advisory committees or groups for the coastal management agencies; (3) workshops can be held to bring together coastal decision makers and managers, other stakeholders, and natural and social scientists, to learn from one another; and (4) informal policy advisory groups can bring the published results of scientific research and monitoring performed outside an agency to the attention of coastal mangers through means such as electronic mail or the World Wide Web.

The NRC report also counsels agencies to involve stakeholders in all phases of the coastal management process, including the planning and application of decision-relevant scientific monitoring. Given that the general public and particular stakeholders will be important in the final decisions made about coastal use, it is important to include them from the outset in the design and conduct of scientific studies, including monitoring, designed to influence the outcomes of coastal decisions. Similarly, governments should encourage the formation of problem-solving task forces or group to address coastal problems that cross subject areas, legal jurisdictions, and policy sectors, using, when appropriate, an ecosystem approach.

A final and critical point is that scientists also need to be encouraged to reach scientific consensus about important coastal problems - something that happens all to rarely given the typically individualistic nature of the scientific enterprise. In this regard, the NRC report encourages professional scientific associations, groups of scientists, and university research consortia to develop syntheses of the state of knowledge on important coastal issues and plans for strategic research and monitoring.

(ii) Enhance Communication among Scientists, Managers, and the Public. The NRC report provides three recommendations for enhancing communications among the groups involved in coastal management efforts: (1) policy makers and implementers should be encouraged to "clearly" identify their short-term and long-term research and monitoring needs and to indicate how the information is to be used, what resources are available to support the collection and analysis of information about natural and social systems, and when the information is needed; (2) government agencies, with the assistance of universities, NGO's and others, should ensure that the results of decision-relevant scientific research and monitoring are summarized in a manner intelligible to the lay public and are widely disseminated to decision makers and the public (one way of accomplishing this would be through requirements imposed on funded research and monitoring projects); (3) agencies, scientists, NGO's, and others should help representatives of the print, radio, and television media to understand and disseminate the results of decision-relevant scientific research and monitoring.

(iii) Build Capacity for Scientist-User Interactions. The NRC report recommends a variety of avenues for capacity building in scientist-user interactions: (1) agencies that have made innovative efforts to apply scientific expertise in the design and implementation of coastal programmes, such as the U.S. Chesapeake Bay programme, should be encouraged to prepare assessments of effective models of science-users interactions as a guide for use in other cases; (2) scientists working within government agencies should be encouraged to maintain their expertise and to stay current with development in their scientific fields; (3) universities should be encouraged to develop cross-disciplinary training of natural and social scientists on coastal topics, i.e., enhance the natural science training of social scientists and vice versa; (4) creation of training programmes for "science translator," i.e., people who can work across disciplines and interact with coastal managers and other users; (5) consortia for strategic research and monitoring should be created to facilitate regular communication of state-of-the-art science to coastal managers, e.g., through summer institutes, trips to research and monitoring sites and laboratories, etc.; (6) the academic reward system should be modified to encourage the involvement of scientists in the policy development and implementation process (a time-consuming activity that is rarely rewarded by academic officials); and (7) government programmes should be evaluated, in part, on the basis of their efforts and successes in incorporating science in their decisions.

(iv) Employ Integrated and Adaptive Approaches and Deploy Sufficient Resources to Improve Interaction. Two final recommendations in the NRC report are to employ integrated and adaptive management approaches in coastal management and to allocate and coordinate resources to improve interaction between coastal scientists and users. To accomplish the latter goal, agencies should (1) require that a portion of scientific research and monitoring budgets be devoted to the translation and dissemination of scientific results; (2) promote, in their requests for proposals for funding, the formation of interdisciplinary teams to carry out decision-relevant scientific research and monitoring; (3) develop mechanisms for better integration of their own policy and science capabilities through such means as data sharing, collocation of facilities, and establishment of cooperative programmes; and (4) facilitate personnel exchanges or staff-sharing arrangements through which scientists, NGO's, and industry personnel spend time in government agencies and government employees work in universities, NGO's, and corporations on temporary assignments.

ANNEX VII

Report on the workshop on Mutual Strengthening of capabilities for the establishment of a regional network on natural hazards warning system FOR SOUTH AMERICA
October 26-28, 1998

The local organizer, Dr. Eduardo Marone, opened the meeting at 13:00 on October 26th 1998 and welcomed the participants to Curitiba/Brazil, thanking them for making their time available for the workshop.

The meeting aimed to identify the operational capabilities present in the participating South American countries, and to discuss the possibilities of establishing a regional information network that could lead to a regional operational information system for the early warning of natural hazards.

The rationale for the establishment of such a network is that coastal systems provide the backdrop against which economic development and land use have been accelerating over the past decade. In particular, most economic and social activities in the South America region have been accompanied by a series of environmental changes that in turn are compounded by increasing incidences of coastal hazards. For those, regional monitoring networks would allow for the establishment of joint priorities for early detection of trends.

The meeting took place at the Federal University of Paraná, Curitiba, Paraná, Brazil, from 26 to 28 October 1998. Discussions were conducted with scientists and representatives from operational agencies from Argentina, Brazil, Chile, Colombia and Uruguay, who presented ongoing activities and identified many environmental problems and issues that presently affect South American countries.

The main marine-related natural hazards in South America include: storm surges; tsunamis; floods/droughts; and harmful algae blooms (HAB). In addition, serious local problems can arise caused by sudden coastal erosion, and sea level rise. Many of these are related to climate and weather, especially tropical storms and depressions.

As an initial approach, each participant exposed their activities, including their local facilities, human resources etc. within their countries, and discussed how those could compose a list of existing observational activities. An inventory of environmental factors was also devised, consisting of natural and anthropogenic hazards that would require permanent observations and data available in real time over the proposed network.

The oceanographic activities that have been maintained on a quasi-permanent and operational basis are:

1. Argentina:

a) regular sea-going activities (temperature and salinity measurements; meteorological observations; fish stock assessment);
b) sea surface temperature by remote sensing;
c) sea level measurements;
d) coastal meteorological stations (limited applications);
e) monitoring of selected beach profiles; and
f) river discharge.

2. Brazil:

a) regular sea-going activities (temperature and salinity measurements; meteorological observations);
b) sea surface temperature by remote sensing;
c) drifting buoy data;
d) sea level measurements;
e) coastal meteorological stations;
f) river discharge;
g) atmospheric vertical profile sounding in the Island of Trindade; and
h) beach profile monitoring at selected sites.

3. Chile:

a) regular sea-going activities (temperature and salinity measurements; meteorological observations);
b) sea surface temperature by remote sensing;
c) sea level and sea surface temperature measurements;

d) coastal meteorological stations;
e) river discharge;
f) Tsunami detection network (member of IOC programme); and
g) national seismographic network.

4. Colombia:

a) hydro-meteorological measurements;
b) sea surface temperature by remote sensing;
c) Tsunami detection (moored-buoy);
d) national seismographic network;
e) coastal meteorological stations;
f) sea level measurements; and
g) tropical winds watch.

5. Uruguay:

a) coastal network for surface salinity and temperature observations;
b) coastal observations of primary productivity on a seasonal basis;
c) sea level measurements;
d) marine meteorological stations;
e) coastal meteorological stations; and
f) river discharge.

On a rather schematic way, those are the data sets already available for exchange on a semi-permanent basis among South American countries:

	Argentina	Brazil	Chile	Colômbia	Uruguay
Physical, chemical, meteorological sea-going observations	YES	YES	YES	YES	YES
Sea surface temperature by remote sensing	YES	YES	YES	YES	-
Sea level measurements	YES	YES	YES	YES	YES
Data from coastal and marine met stations	YES	YES	YES	YES	YES
Monitoring of selected beach profiles	YES	YES	-	-	-
Monitoring of river discharge	YES	YES	YES	-	-
Fish stock assessment	YES	-	-	-	-
Drifting buoy data	-	YES	-	-	-
Atmospheric vertical profile sounding in selected regions	-	YES	-	-	-
Tsunami detection network	-	-	YES	YES	-
Data from national seismographic network	-	-	YES	YES	-
Tropical wind watch	-	-	-	YES	-
Coastal observations of primary productivity on seasonal basis					YES

After identification of an initial data set that would trigger the implementation of the network, discussions followed concerning data availability and free exchange.

MAIN RESULTS:

The workshop presented a very good opportunity for those countries that have not yet created a system of coastal data information to share experiences on how to develop one in their own countries.

Within each country, data collection and dissemination rely on different agencies and are presented in different stages of development. Data sets exist, but are not always available and even less so on a routine basis, to the general public. The vital element of this proposed service to the coastal region is to readily access the wide range of data required to support analysis, prediction and elaboration of products of common regional interests.

Operational oceanography in South America faces difficulties in maintaining a systematic collection, processing, and dissemination of data products due to several factors that include: inadequate data quality control protocols; lack of resources for maintenance of the already implemented national observing systems (tide-gauge network, for instance); lack of adequate inter-calibration procedures and inter-comparison for existing data products; inadequate infra-structure support for data analysis, interpretation and dissemination; lack of appropriate data archeology (digitalization) procedures and formats; and finally, lack of human resources to address some of the issues above.

It was clear, however, that several institutions in the region are already integrating coastal information and data into networks, in an operational way, but for their specific and national use only. Some other countries are already producing regular bulletins on the monitoring of some coastal variables and also publishing products and reports on the Internet on a regular basis.

Co-operative work at the regional level was identified as a key to pursuing wider objectives in operational oceanography in the coastal zone of South America. The beginning of the infrastructure for the regional network to provide advance warning of natural hazards to coastal populations was formed during this workshop, and other points of possible cooperation were identified. It was recognized that the network could make a contribution to the Coastal GOOS programme, and in consequence the group accepted the challenge of working on the design of a draft of pilot project for South America, to be submitted to the Coastal Panel of GOOS. It is important to notice that the proposed project does not start from scratch but takes onboard the already existing activities in each of the countries involved. There will be immediate implementation of a cooperative network of institutions having common interests in the coastal zone, led by Ernesto Forbes (Uruguay). The development of a web page as a prototype for the dissemination of data and forecasts will also be immediately put forward by Eduardo Marone (Brazil).

REQUIRED PLAN OF ACTION and FOLLOW-UP:

National capabilities in marine sciences and services to support the future implementation of a regional network are at different levels of development in South America. The strengthening of those capacities and the implementation of an integrated information network that would bring up the involved countries to a common level of development is sought. This is particularly important in regard to knowledge and technology transfer. The whole process starts with raising awareness of the local needs for setting up a coastal observational system that could ultimately be a very important tool for regional coastal management and provide the basis for an effective co-ordination for disaster prevention in the region.

There must be a long-term investment in strengthening the existing facilities, sharing of commonalties, searching for external support, and investment in human resource training in delivering services and products, which should reflect societal needs. Based on the operational oceanography activities described for the region, one can infer that the first financial commitment is already in place in most countries.

In the near future, the required actions to start implementing the regional network are:

a) to encourage the participation of other countries from the Pacific coast, with the aid of IOC;
b) to improve existing regional capabilities through mutual consultations and the definition of bilateral or multilateral action plans;
c) to identify further facilities and human resources on a country-by-country basis;
d) to strengthen and update existing observing systems (for instance, the South American tide-gauge network);
e) to promote, whenever possible, regional meetings to improve data exchange procedures; and
f) to organize a future workshop to consolidate all proposed planned actions into an implementation strategy.

The expected benefits to be transferred to society with the implementation of the regional network are:

a) improvement of forecasting services (for surges, tsunamis, ENSO-triggered phenomena, etc.);
b) an integrated coastal erosion monitoring project;
c) prevention and/or mitigation of natural hazards;
d) provision of strategic information for decision-makers (i.e. ENSO-related socio-economic activities); and
e) enhancement of information by integration of data and products between each forecasting agency.

The final step would be to determine how such national networks could interface to regional observing systems and coordinate with several other common projects, programs and activities developed by South American countries. These include the tsunami watch network, El Niño forecasting groups in the Pacific, PIRATA project in the Atlantic, GLOSS and its network of sea-level stations, meteorological services and stations, the HAB network for South America and relevant UNEP Regional Seas programs.

The needs for training and capacity building are issues that must go along with the setting up of this regional network, under the GOOS umbrella.

It was noted that the IOC and the EU have initiated an oceanographic network among Latin American and some European countries where the proposed early warning network would fit nicely and be an important integral part.

CLOSURE:

The local host Dr. Eduardo Marone thanked all participants for putting forward their energy and anticipated commitments to make the regional network initiative move forward in their countries.

He also thanked IOC, UNEP, TWAS and the Federal University of Paraná for supporting and sponsoring the workshop that most certainly will have a positive and immediate follow-up.

The workshop was adjourned at 1900 hours on October 28th.

ANNEX VIII

Coastal GOOS in Context: Review the goals, plans and recommendations of OOPC, HOTO, LMR, and Capacity Building Panels that are relevant to the formulation of strategic (design) and implementation plans for C-GOOS

Tom Malone, Osvaldo Ulloa, George Needler and Colin Summerhayes

I. GOOS

A. OVERVIEW

The Global Ocean Observing System (GOOS) was created in 1992 in response to conventions signed at the UN Conference on Environment and Development (UNCED, Rio de Janeiro, 1992). The UNCED conventions called for the establishment of an adequate observing system to monitor the oceans and develop sufficient of environmental change to achieve the goals of sustainable development and integrated management of the marine environment and its natural resources. To these ends, the goals of GOOS are to improve

(i) weather forecasts and climate predictions,
(ii) now-casting and forecasting for safe marine operations and the mitigation of natural hazards, and
(iii) documentation and prediction of the effects of human activities and climate change on marine ecosystems and the living resources they support.

GOOS is based on an "end-to-end" design in which the requirements of end-users of marine information generate a demand for services and products and define the observations, time scales, and means for their delivery. GOOS is intended to address issues that are global in scope as well as those that occur on smaller (local-regional) scales but are globally ubiquitous and would benefit from comparative analysis or from data and information collected on larger (regional-global) scales. The role of the GOOS is to promote the establishment of the integrated, multi-disciplinary observation systems required to achieve these goals in cases requiring information on scales that are beyond the capabilities of any individual nation. There are five operational objectives:

(i) specify the measurements (variables, resolution, precision, etc.) and information needed on a continuing basis to meet the common requirements of user groups on regional to global scales;
(ii) develop and implement an internationally coordinated strategy for the timely acquisition, analysis and archival of data for applied purposes;
(iii) promote the application of environmental data and products by user groups;
(iv) enable smaller and less-developed nations to participate and benefit from GOOS; and
(v) coordinate with GCOS, GTOS and other observation programmes and ensure their integration into regional-global management strategies.

Implementation of GOOS will build upon existing observation programmes and elements. The success of GOOS will depend on the demonstration of tangible benefits in a timely fashion. This will be achieved by promoting expansion and implementation of operational monitoring programmes, networking programmes on regional to global scales, and linking measurements to products and services through an end-to-end approach to data management.

Five panels have been formed to prepare plans for the strategic design and implementation of GOOS:

(i) The Ocean Observing Panel for Climate (OOPC) to provide the data from the oceans needed for the prediction of climate variability and climate change (GCOS);
(ii) Health of the Oceans (HOTO) to provide data needed to assess the nature and extent of the effects of anthropogenic contaminants on human and ecosystem health;
(iii) Living Marine Resources (LMR) to provide data needed for the sustainable management of living marine resources in an ecosystem context;
(iv) Coastal (C-GOOS) to provide data needed to now-cast, forecast and predict environmental variability and change as a means of preserving healthy coastal environments, promoting sustainable uses of coastal resources, mitigating coastal hazards, and ensuring safe and efficient marine operations; and
(v) Ocean Services to identify products and services in response to user needs.

GOOS panels are charged with (1) developing strategic design plans; (2) planning and implementing pilot projects as proof of concept, operational demonstrations; and (3) formulating implementation plans. Pilot projects are also intended to stimulate the development of new technologies (e.g., sensors, telemetery, data assimilation and model development). In the case of C-GOOS, **successful pilot projects will provide the "seeds" (and guidelines) for implementing GOOS in the coastal zone**. C-GOOS will also be implemented through regionally organized initiatives such as EuroGOOS, NEAR-GOOS, and the UNEP Regional Seas Programme, as well as through nationally organized initiatives such as U.S. GOOS and Brazil GOOS. C-GOOS strategic and implementation plans will incorporate plans and recommendations from the OOPC, HOTO and LMR panels as appropriate.

GOOS Panels report to the GOOS Steering Committee (GSC, Worth Nowlin, Chair) which is responsible for the planning and implementation of GOOS. The Intergovernmental Committee for GOOS (I-GOOS, Angus McEwan, Chair) represents national interests and is responsible for endorsing GOOS actions on behalf of member nations. I-GOOS provides a forum for interaction with governments, whose approval and resources will be needed to implement GOOS.

Conceptually, GOOS can be divided into two related components, a basin-scale component concerned primarily with the role of the oceans in global climate change and a coastal-scale component concerned primarily with the combined environmental effects of climate change and human activities at local to regional scales. The GSC has begun to discuss the possibility that the OOPC, HOTO, LMR, and Ocean Services modules will eventually be integrated into basin scale and coastal GOOS modules.

Support for planning and international coordination of the design and implementation of GOOS is provided by the sponsors of GOOS: the IOC, WMO, ICSU and UNEP.

B. END-TO-END DATA MANAGEMENT

The achievement of a predictive understanding of environmental change in coastal ecosystems depends, among other things, on the development of regional to global networks that link observation, analysis and application in more effective and timely ways. The goals of "end-to-end" data management are to maximize the use of data and information on coastal habitats and natural resources by optimizing the flow of data and information from sensor to user and to increase the cost-effectiveness of environmental observations. This will be achieved by (i) developing more effective linkages between the providers of data on environmental change and user groups, (ii) minimizing data delays, losses and redundancy, (iii) improving metadata records, (iv) documenting quality assurance and control procedures, and (iv) increasing access to data and information.

User groups include government policy and decision makers, government agencies (e.g., harbors and maritime services, environment, natural resources), private industry (e.g., shipping, fishing, tourism, insurance, construction, farming, mariculture), environmental NGOs, educators and the public, and the scientific community. Science is a critical link that transforms measurements into useful information. Facilitating access to information on environmental change and the causes and consequences of such change is at the core of all GOOS goals and objectives. The establishment of comparable and equivalent procedures for data management for GOOS, GCOS and GTOS is the responsibility of the Joint Data and Information Panel (J-DIMP). In this context, J-DIMP must take into account a greater diversity of potential user groups in C-GOOS relative to other GOOS modules.

The economic case for GOOS emphasizes short-term economic benefits. The economics of global climate change illustrate the rationale that led to this conclusion. The economic impacts of climate change will probably become serious in 30-50 years. Since GOOS requires initial investments in hardware, communications, and products in its early stages, potential benefits must be enormous over this time frame to justify spending large sums of money now. Although the worst case scenarios for climate change might justify such expenditures if the nature of environmental changes and their impacts were certain, it is more difficult to make this case when impacts are unquantified probabilities.

The emphasis on short-term economic benefits does not mean a return to the divisiveness of the early 1980s. For example, advances in numerical modeling techniques and geographic information systems enable scientists, planners and managers to assimilate and integrate large amounts of data from different sources and to generate informative products that are responsive to user needs in more timely ways. It will not be easy to achieve this goal, but it is possible.

C. COASTAL GOOS: AN APPROACH (September, 1996)

The role of Coastal GOOS is to promote coordination among current observing systems and the coordinated implementation of new observations for cost-effective

(i) determination of the current status of coastal ecosystems and resources,
(ii) detection of changes and trends,
(iii) evaluation of the efficacy of coastal management actions,
(iv) validation and verification of predictive models,
(v) enhancement of knowledge of coastal processes,
(vi) early warning of future problems (from natural hazards and the effects of land-use to climate change), and
(vii) timely distribution of real-time observations and forecasts to guide routine and emergency marine operations to improve the safety and efficiency of marine operations.

No single sampling design can efficiently provide all information needed to evaluate coastal conditions and guide all policy decisions. C-GOOS is conceived as an intergrated, hierarchical structure of networks, from synoptic remote sensing to intensive *in situ* monitoring sites, from data collection to transfer and analysis. GOOS observations are those that are long-term, systematic, routine, globally relevant, and cost-effective.

C-GOOS must take into account energy and material inputs from land, sea and air. The scope of C-GOOS must, therefore, include these inputs as well as the coastal and shelf waters, estuaries, coastal watersheds, wetlands, floodplains, lagoons, and intertidal habitats that constitute the aquatic ecosystems of the coastal zone. C-GOOS will have significant overlap with terrestrial and atmospheric observing systems in the coastal zone, and it is expected that a single coastal module will eventually evolve that links GOOS, GCOS and GTOS.

There is a need for a new paradigm of multidisciplinary coordination and collaboration among (i) research, monitoring, assessment and management activities; (ii) marine, atmospheric and terrestrial scientists; (iii) local, state, federal and internations institutions; (iv) the scientific community, private industry and the public; and (v) conservation and economic development interests. A great deal must be done to entrain user groups in order to define and solve local environmental problems. Considerations include national priorities, common standards, and data management. Emphasis should be placed on community-based solutions and consensus building among stake-holders, processes that must begin during the early design phase of all GOOS projects.

D. C-GOOS I: SUMMARY OF MALONE'S PRESENTATION TO THE GSC (Paris, 20-23 April, 1998)

The challenge to C-GOOS is large, but the benefits of implementation are enormous. The charge is to promote the design and implementation of end-to-end systems that are responsive to user needs in the coastal zone and beyond the capabilities of individual nations to address in isolation. C-GOOS will consult with and advise a broad range of users on how to develop observing systems that meet local-regional needs, employ common standards and comparable methods, benefit from regional and global observations, and provide the means to interpolate among systems and extrapolate to future states.

At its first meeting, the C-GOOS Panel emphasized 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**. In this context the panel agreed on the following goals:

(i) determine user needs and specify data and products required to satisfy these needs;
(ii) identify regions where current monitoring programmes are inadequate and formulate plans to fill these gaps;
(iii) identify inadequacies in measurement programmes and develop recommendations for improvements in terms of variables measured, the scales on which they are measured, and their usefulness ;
(iv) promote regional to global coordination and integration of monitoring, research and modeling;
(v) promote the design and implementation of internationally coordinated strategies for data acquisition, integration, synthesis and dissemination of products; and
(vi) promote the implementation of regional to global networks to improve now-casting, forecasting and prediction of environmental change.

An intersession Action Plan was formulated with the objective of completing the Strategic Design Plan by the end of CY 1998 and initiating Pilot Projects during 1998-99. The Implementation Plan will be completed in 2000.

Operational categories were defined (preserve healthy environments, promote sustainable use of resources, mitigate hazards, safe and efficient marine operations) and used to organize environmental issues and problems that are globally ubiquitous and locally significant. Systematic approaches to linking measurements to user needs and assessing the cost-benefit of measurement programmes were developed and are being evaluated by intersession *ad hoc* committees.

The Panel recognized that important observing systems are already in place in some key regions and that these should be promoted and coordinated under the umbrella of C-GOOS. To assess the appropriateness of these ongoing operations for C-GOOS, the IOC agreed to compile and make available information on significant coastal monitoring programmes conducted by its Member States. This will include both a description of current programmes and an assessment of the timeliness of access to and analysis of environmental data. A status report on this effort will be given at C-GOOS II (Fall, 1998). The Panel will develop recommendations for integrated, multidisciplinary observing systems based on current programmes and needs. This includes the entire end-to-end system from from sensors and measurements to data dissemination and analysis for the purposes of nowcasting and forecasting environmental changes and responses to environmental change. C-GOOS will liaise closely with ongoing GOOS programmes (e.g., LMR, HOTO, NEAR-GOOS, EuroGOOS) and with research programmes relevant to the GOOS mission (e.g., I-LTER, LOICZ).

The Panel's Action Plan includes assessments that will lead to recommendations for coordinating with, complementing and building on related programmes (GTOS, GCOS, EuroGOOS, NEAR-GOOS, OOPC, HOTO, LMR, LOICZ, LTER); for procedures that can be used to design Pilot Projects and evaluate the cost-effectiveness of measurement programmes; and for involving all major stakeholders in the planning and implementation from time zero. Proposals are being developed for potential projects in the eastern south Pacific, western Pacific, the Black Sea, and the northern Adriatic; for projects to improve remote sensing algorithms, disaster mitigation (storm surge), and the networking of metadata; and for projects that will lead to more systematic documentation and effective prediction of harmful algal blooms and habitat loss (submerged attached vegetation).

In terms of the need for observing systems that capture important scales of variability, a U.S. C-GOOS workshop is being planned to address the "Challenges and Promise of *in situ* Sensing for Nowcasting, Forecasting and Predicting Environmental Trends in Coastal Ecosystems." The workshop will address three related issues: (i) detecting and predicting change in coastal ecosystems; (ii) monitoring capabilities and information needs; and (iii) the design and implementation of integrated, multidisciplinary coastal observing systems. It will lay the foundations for the design and implementation of U.S. C-GOOS. It is anticipated that this will be followed by an international workshop to address global aspects of these issues, including the need for capacity building.

The panel's report was accepted and its agenda of four meetings in 1998 and 1999 was endorsed by the GSC. In addition to the April, 1998 in Paris the tentative schedule is as follows: C-GOOS II in Curitiba, Brazil, Oct-Nov, 1998; C-GOOS III in west Africa, March, 1999; and C-GOOS IV in association with EMECS 99 in Ankara, Turkey, Nov, 1999.

The GSC endorsed or recommended the following actions:

(i) meet twice a year to keep the momentum going;
(ii) invite a representative of the GTOS panel to C-GOOS panel meetings and vice versa to insure coordination and collaboration;
(iii) consider specific user needs at future C-GOOS panel meetings;
(iv) insure coordination and collaboration with the HOTO and LMR panels;
(v) consider merging the designs of C-GOOS, LMR and HOTO into a single module once the design phase of each is completed;
(vi) develop indicators of change that will be useful to users;
(vii) the GPO and the HOTO and C-GOOS Panels must explore ways to better coordinate with the UNEP Regional Seas programme; and
(viii) the GPO should respond to the panels request for information on significant coastal monitoring programmes conducted by its member states. This should include both a description of current programmes and an assessment of the timeliness of access to and analysis of environmental data.

II. RELATED PANELS

The C-GOOS Panel must take into consideration plans and recommendations of the OOPC, HOTO, LMR, and Capacity Building panels as they relate to the design and implementation of GOOS in the.coastal zone.

A. OCEAN OBSERVATIONS PANEL FOR CLIMATE (OOPC; Neville Smith, Chair)

The goals of the OOPC are to (i) monitor, describe and understand the physical and biogeochemical processes that determine ocean circulation and its influence on the C cycle and the effects of the ocean on seasonal to multi-decadal climate changes; (ii) provide the observations needed for the prediction of climate variability and climate change; and (iii) develop the Global Ocean Data Assimilation Experiment (GODAE). GODAE has been formulated as a pilot project to assist in implementing GCOS. The purpose of this effort is to demonstrate the power of integrating satellite and *in situ* data, the power of model assimilation, and te value of a global system. It is needed for open ocean analyses and forecasts and for establishing boundary forcings for regional models so as to improve forecasting in coastal systems. Several initial test phases will be conducted over the next few years leading up to a full scale global experiment in 2003-2005. A North Atlantic data assimilation pilot project has been proposed. The need now is human resources and money. The patrons (e.g., NOAA, NASA, CNES, EUMETSAT, STA, JAMSTEC) have established a GODAE fund which now supports the GODAE office (in the Bureau of Meteorology, Melbourne, Australia).

The OOPC welcomes the opportunity to develop a joint project with the C-GOOS panel and emphasizes the importance of further studies on the coastal-open ocean interface. The GSC has formed an inter-session group (chaired by Erlich Desa with Llana Wainer and Mike Fogerty) to examine opportunities for taking advantage of GODAE within the broader context of GOOS including its relationsip to non-physical components, regional models and applications, and outreach to entrain developing countries.

The effects of meteorological events, large scale climate change and oceanic processes on coastal ecosystems are clearly important to C-GOOS. In addition to coordinating with the OOPC and the inter-session work group referred to above, **C-GOOS will coordinate with the SCOR Working Group on Coupling Winds, Waves and Currents in Coastal Models** (Co-Chaired by Norden Huang and Chris Mooers). This WG will examine critical issues related to coupling between wind forcing, surface waves, and currents in the coastal ocean and review existing observational data to define future needs for understanding the coastal region as a whole. Questions to be addressed that are relevant to C-GOOS include

(i) What processes govern the generation and propagation of waves across the shelf?
(ii) How does the partitioning of energy and momentum fluxes among waves and currents change with time and across the shelf?
(iii) How do wave-driven changes in surface mixed layer structure affect wind-driven currents?
(iv) What are the effects of waves on the magnitude and directional characteristics of surface wind stress?
(v) How significant are wave refraction (and associated breaking) and wave-current interactions in controlling wind-driven currents and are their significant feedback effects?
(vi) How does the coupled model differ from uncoupled models?
(vi) What is the role of coastal waters in the global exchange of heat between oceans and atmosphere and as a boundary condition for global climate studies?

The focus of the WG will be on special issues related to the development of a coupled coastal wind-wave-circulation model for assessing the health of the coastal environment and estimating the role of coastal waters in global ocean dynamics.

The effects of oceanic processes and climate on coastal ecosystems should be a major agenda item at C-GOOS III. The OOPC Panel feels that, to the extent possible it could be profitable to carry this forward on a cooperative basis. This is also a major concern of GODAE. Coastal needs can both provide some justification for the global climate observing system and should provide some criteria against which the present design can be tested for adequacy.

B. HEALTH OF THE OCEANS (HOTO) PANEL

The strategic plan has been completed and implementation of the HOTO Module will be within the framework of the Global Investigation of Pollution in the Marine Environment (GIPME) Programme of the IOC, UNEP and IMO. Coordination among the northeast Asian HOTO Pilot Project to the northwest Pacific Action Plan (NOWPAP, a UNEP Regional Seas initiative) is in progress. Implementation is intended to occur region by region in cooperation and collaboration with the implementation of the LMR and C-GOOS modules.

As articulated in the panel's strategic plan (May, 1996), the primary goals are to provide information on the nature and extent of adverse effects of anthropogenic contaminants on human health, marine resources, and ecosystem health. Data collection, bio-monitoring and assessments of biological effects are to be conducted on regional-global scales using commonly agreed upon standards and methods. Initial emphasis will be on (i) development of reliable biological indicators of ecosystem health; (ii) monitoring contaminant loadings in relation to ecological responses; (iii) developing methods for evaluating the assimilation capacity of coastal ecosystems for contaminant loads; and (iv) assessing available data on contaminant levels and biological responses to establish regional and national baselines and mass balances (budgets).

Global issues of contemporary concern that impact on or are related to the health of the oceans include climate change, endangered species, biodiversity, human health, tourism and eutrophication. Priority issues were defined and classes of contaminants were chosen for attention. Anthropogenic activities that mobilize contaminants include aquaculture, forest disturbance, coastal development, marine transportation, industrial discharge, ocean dumping, agriculture, extraction of minerals, and human waste discharge. The strategic plan includes a listing of systems ranked according to contaminant loadings. In this list, the Black Sea is most contaminated and the Red Sea is least contaminated. Heavily contaminated systems included Asian seas, the Great Lakes, the Baltic Sea, and the N. Sea Although an incomplete listing, this approach provides a means of prioritizing HOTO efforts.

Biological indices of contaminant stress must be identified at molecular, organismal, population and community levels of biological organization. In addition, relating loads to biological effects will require measurements on different time and space scales depending on the nature of the problems being addressed. Measurement can be divided into three categories: (i) those needed for management decisions that are driven by the requirements of customers who require interpretative products; (ii) those required to capture responses to changes in patterns of loading and physical forcings; and (iii) those required to resolve the effects of substances that are derived from both natural an anthropogenic sources.

Pilot projects have been planned or discussed for the (i) Red Sea, (ii) southeast Asian Seas, (iii) northeast Asian region, (iv) Arctic, (v) Antarctic, (vi) Black Sea, (vii) Brazilian coastal zone, and (viii) Caribbean. The format f or pilot project proposals ("Frameworks for Regional Blueprints") is as follows: (i) introduction or background section which describe the system, relevant environmental issues, user groups and needs; (ii) description of existing programmes that collectively could form the basis of the project; and (iii) project design that includes goals, description of the observational network, variables to be measured, scales (resolution, duration, areal extent) of measurement required to resolve variability and trends, data management (assimilation, QAQC), and modeling.

[Note: For C-GOOS, **project design should include completion of the project design table and cost-benefit analysis of variables to be measured.**]

[Note: The Brazilian coastal zone pilot ("Rapid Assessment of Marine Pollution (RAMP): a HOTO Pilot Project in South America") is intended to provide equipment and training for easy to use, inexpensive technologies to measure chemical and biological markers needed to assess environmental impacts and improve environmental management.]

The GSC asks that the HOTO Panel chair liaise with the C-GOOS chair to arrange data sharing and dissemination of activities.

C. LMR (Warren Wooster, Chair)

The LMR module will provide a framework and specification for an adequate package of observations and research to understand and forecast major changes in the abundance and production of critical living marine resources over time scales of years to decades and beyond. It will identify user requirements for oceanographic data and give advice on the design and implementation of the observing system. Specific aims include monitoring and prediction of

(i) ecological variables (physical environment, trophic levels that support living resources);
(ii) sustainability of critical marine habitats (estuaries, lagoons, and upwelling systems; coral reefs, grass beds, mangroves and other coastal wetlands)
(iii) regime shifts and changes in recruitment (decadal scale fluctuations in ecosystem structure-function with superimposed interannual variability in recruitment);
(iv) changes in marine biodiversity;
(v) information relevant to the conservation of genetic resources; and

(vi) impacts of anthropogenic stressors on the health of marine ecosystems including the occurrence of toxic algal blooms.

Many of these topics overlap with other GOOS modules and coordination will be needed to insure comprehensive coverage. It is assumed that portions of the physical and chemical data and modeling required by LMR will be obtained through observing and modeling systems specified by the OOPC, HOTO and C-GOOS panels. In addition, the work envisaged for LMR is closely related to that planned by the SCOR/IOC/IGBP Core Project on Global Ocean Ecosystem Dynamics (GLOBEC). The relationship with GLOBEC is very important because its mission is to advance understanding of precisely those features of the marine ecosystem which LMR aims to monitor and predict. Indeed, it is probable that if GLOBEC did not already exist, LMR would have needed to create it.

The new LMR Panel recognizes that there is potential overlap with the work of the Coastal and HOTO Panels. Initially, the panel will focus on offshore regions dominated by oceanic processes and then move shoreward. Estuaries are perceived as being beyond the scope of the panels work. Coordination with the C-GOOS and HOTO Panels, and with GLOBEC and the LMR Programme (especially in the Gulf of Guinea), will be important. The panel has also requested the IOC to compile an inventory of relevant environmental monitoring and stock assessment programmes of Member States.

The panel also recognizes that fisheries data collected by individual nations may not be in a form that will allow integration and comparative analysis. Accordingly, the panel has asked the FAO to identify the existing fisheries data bases that could contribute to regional and global assessments and to advise on how to conduct such assessments.

Pilot projects will involve retrospective analyses of data from well sampled regions where significant ecosystem changes have been observed (e.g., regime shifts in the Northeast Pacific) to evaluate (i) the predictability of such changes, (ii) the extent to which predictions could be improved with the measurement of additional variables. Intersession pilot projects were proposed for the Baltic, California Current, Japan Sea/East Sea, northwest Atlantic, northeast Atlantic, and the Benguela Current.

The GSC recommended that the panel broaden the scope of the module to include coastal seas and the nearshore coastal environment. The panel has been asked to complete a draft design plan for implementation within 18 months in order to mesh the process more closely with the time schedule set by the C-GOOS panel.

D. CAPACITY BUILDING (Jan Stel, Chair)

Because of the global nature of GOOS, the full involvement of all nations will be critical to its success. To maximize the benefits that developing countries can realize, there will be a need for capacity building. This should include education and training and infrastructure enhancements including sampling platforms, instrumentation, access to remotely sensed data, and communication networks for data telemetry and dissemination. It has been recommended that capacity building be conducted as an integrated GOOS-wide activity and that pilot projects should include capacity building elements.

GOOS Capacity building has been directed by an *ad hoc* panel. Four workshops have been conducted: (i) Goa, India, Nov 96; (ii) Mombasa, Kenya, Mar 97; (iii) Malta, Nov 97; and (iv) Suva, Fiji, Feb 98. The Malta and Fiji meetings respectively planted the seeds for two regional GOOS programmes: MED-GOOS and Pacific-GOOS. These efforts are leading to useful inventories of capabilities, more precise definition of needs, and identification of desired products.

The GSC concluded that there is a need to continue GOOS capacity building by formally establishing a Capacity Building Panel with terms of reference (to be chaired by Jan Stel with Allyn Clark and Ilana Wainer). The Panel will need to coordinate closely with the IOC TEMA (Training, Education and Mutual Awareness) programme and with other GOOS Panels. Each of the current GOOS Panels (OOPC, C-GOOS, LMR, HOTO) is to **identify a member who will be responsible for capacity building and who would liaise with the Capacity Building Panel**. The Panel will be charged with developing design and implementation plans that include the following key elements:

(i) development of funding sources;
(ii) developing links with IOC regional bodies and the IOC Vice Chairman for regional development;
(iii) coordinating capacity building efforts of other GOOS panels and programmes and with TEMA;
(iv) focusing on providing practical benefits to developing countries, especially improving data and information management as the basis for data exchange and product development; and

(v) placing extension agents in selected regions to assist with the development of GOOS programmes that are locally and regionally relevant.

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LMR

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ANNEX IX

SUMMARY OF HOTO STRATEGIC PLAN

The Health of the Oceans Module is intended to provide a basis for determining prevailing conditions and trends in the marine environment in relation to the effects of anthropogenic activities, particularly those resulting in the release of contaminants to the environment. Data collection, biomonitoring and biological effects assessments will be conducted on both global and regional scales using common standards and methods. Area of emphasis will be: (1) development of a set of reliable, routinely measured indices of the health of the marine environment; (2) monitoring concentrations and trends of contaminant loading in coastal waters in relation to community responses; (3) development of methods for the evaluation of the capacity of coastal ecosystems to assimilate contaminants; and (4) reclamation of available data on contaminant levels and community responses as baseline information for HOTO monitoring acitivities.

The panel identified issues that are contemporary concern: climate change, endangered species, biodiversity, human health, tourism and eutrophication. Collectively, these relate to the following classes of contaminants and properties chosen for attention within the HOTO module: aquatic toxins, artificial radionuclides, pesticides, herbicides, pathogens, litter, nutrients, oxygen, synthetic organic compounds, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, suspended particulate matter, trace metals, phytoplankotn pigments and pharmaceuticals. In addition to measuring concentrations, indices of health will have to be identified at for four levels of biological organizations: molecular, organismal, population and community.

The panel selected a number of geographic areas for which sufficient knowledge exists to assess the relative importance of contaminants and assigned relative priorities to regions in terms of levels of contamination. This is by no means a complete list and the ratings are based on the expertise of the panel members who were present. A zero (-) was assigned to properties of little regional interest. Numerical values of 1, 2, and 3 were given to low (L), medium (M) and high (H), respectively. Not surprisingly, the most polluted systems (e.g., the Black Sea) are all inland seas. Nutrients and pathogens were cited most frequently as being major problems.

Ranking of marine systems in terms of their level of human impact: 1- Caribbean, 2 - Northern FSU, 3 - North Sea, 4- West Africa, 5 - Baltic Sea, 6 - Mediterranean, 7 - Red Sea, 8 - The Gulf, 9 - Asian Seas, 10 - Black Sea, 11 - Oligotrophic Central Gyre, 12 - Great Lakes.

Property	1	2	3	4	5	6	7	8	9	**10**	11	12	Total
algal toxins	H	-	M	-	M	M	L	L	H	M	-	?	16
radionuclides	-	H	M	-	L	L	-	-	-	H	-	L	11
litter	M	M	L	H	M	H	M	L	M	H	L	H	25
pathogens	H	L	H	H	M	H	M	H	H	H	-	H	29
nutrients	H	L	H	H	H	H	L	H	H	H	H	H	32
dissolved O_2	-	-	-	M	H	M	-	-	M	H	L	H	16
synthetic organics	L	M	M	M	M	M	L	L	L	H	L	H	21
petroleum	H	M	M	M	L	M	H	H	H	H	L	L	26
PAHs	L	M	M	M	M	M	H	H	M	M	L	M	24
SPM	H	L	L	M	M	L	L	H	H	M	-	L	20
trace metals	L	L	M	L	L	L	L	L	L	M	L	M	15
pigments	M	L	H	L	H	M	L	-	H	H	-	H	21
pharmaceuticals	-	-	M	L	L	L	-	L	L	L	-	L	9
totals	25	18	27	25	29	27	16	20	30	37	10	29	

ANNEX X

COMPONENTS AND STATUS OF UNEP'S REGIONAL SEAS PROGRAMME

This document lists the conventions and action plans of the UNEP Regional Seas Programme (based on information provided by Arthur Dahl of UNEP, Geneva).

UNEP has collaborated with groups of governments sharing a common sea area to establish Regional Seas Conventions and Action Plans. For some of these, UNEP has been given responsibility for secretariat functions under the Convention, usually with a Regional Coordinating Unit established in the region. For others, another intergovernmental organization provides the secretariat, with the intergovernmental activities continuing to form a part of the Regional Seas Programme. Other Regional Seas Programmes and Action Plans are still under development, or have not adopted an international legal instrument, and are directly administered by UNEP with guidance from the Governments of the region through intergovernmental meetings. In all, programme activities are determined largely by the Conferences of the Parties or other intergovernmental meetings and funded by regional trust funds or the funds of the responsible regional organization.

1. MEDITERRANEAN ACTION PLAN

UNEP is responsible for the Secretariat of the Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention), and its Action Plan, through the Mediterranean Regional Coordination Unit (MEDU) in Athens, Greece:

Mr. Lucien Chabason
Coordinator
Coordinating Unit for the Mediterranean Action Plan
Vas. Konstantinou 48
P.O. Box 18019
11610 Athens, Greece
Tel: +30 1 727 3100 [NEW NUMBER], direct 727 3101
Fax: +30 1 725 3196-7
E-mail: unepmedu@unepmap.gr, chabason@unepmap.gr

The Secretariat is responsible to the Conference of Parties to the Barcelona Convention, comprising Albania, Algeria, Bosnia-Herzegovina, Croatia, Cyprus, EU, Egypt, France, Greece, Israel, Italy, Lebanon, Libya, Malta, Monaco, Morocco, Slovenia, Spain, Syria, Tunisia, Turkey and Yugoslavia.

The Secretariat administers the programme for the Convention for the Protection of the Mediterranean Sea Against Pollution, including the Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft, the Protocol Concerning Cooperation in Combatting Pollution of the Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency, the Protocol for the Protection of the Mediterranean Sea Against Pollution From Land-based Sources, the Protocol Concerning Mediterranean Specially Protected Areas, and the Protocol for the Protection of the Mediterranean Sea Against Pollution Resulting From Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil. It supervises a number of Regional Activity Centres around the region. The Secretariat also is responsible for the regional Sustainable Development activities agreed to by the Governments of the Mediterranean region.

2. KUWAIT ACTION PLAN

An independent regional intergovernmental organization, the Regional Organization for the Protection of the Marine Environment (ROPME), comprising Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates, was established to implement the Convention and Action Plan. The Secretariat in Kuwait is headed by the Secretary-General of ROPME, who reports to the ROPME Council of Ministers:

Regional Organization for the Protection of the Marine Environment (ROPME)
P.O. Box 26388
1324 Safat
State of Kuwait
Tel: +965 531 2140/3
Fax: +965 532 4172 and 531 2144

The Kuwait Regional Convention for Cooperation on the Protection and Development of the Marine Environment and the Coastal Areas, includes the Protocol Concerning Regional Cooperation in Combatting Pollution by Oil and Other Harmful Substances in Case of Emergency, the Protocol Concerning Marine Pollution Resulting From Exploration and Exploitation of the Continental Shelf, and the Protocol for the Protection of the Marine Environment Against Pollution From Land-based Sources.

3. RED SEA AND GULF OF ADEN ENVIRONMENT PROGRAMME

An independent regional intergovernmental organization, the Programme of Environment for the Red Sea and the Gulf of Aden (PERSGA), was established to implement the Convention. The Secretariat in Jeddah, Saudi Arabia, is headed by the Secretary-General of PERSGA, who reports to the PERSGA Council of Ministers, comprising Egypt, Jordan, Palestine, Saudi Arabia, Somalia, Sudan and Yemen:

Red Sea and Gulf of Aden Environment Programme (PERSGA)
P.O. Box 1358
Jeddah 21431
Saudi Arabia
Tel: +966 2 651 4472 and 651 9868
Fax: +966 2 651 1424 and 651 9868

The Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment includes the Protocol Concerning Regional Cooperation in Combatting Pollution From Oil and Other Harmful Substances in Cases of Emergency.

4. WEST AND CENTRAL AFRICAN REGION (WACAF)

UNEP serves as the Secretariat of WACAF, through a Programme Officer in the UNEP Water Branch. The Secretariat will be established in Abidjan, Cote d'Ivoire, in the near future:

Water
UNEP
P.O. Box 30552
Nairobi
Kenya
Tel: +254 2 62 1234
Fax: +254 2 62 2788 and 62 2798

The Secretariat is responsible to the Conference of the Parties to the Convention for Protection and Development of the Marine and Coastal Environment of the West and Central African Region, which comprises Angola, Benin, Cameroon, Cape-Verde, Congo, Cote d'Ivoire, Democratic Republic of Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mauritania, Namibia, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone, and Togo.

The Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region includes the Protocol Concerning Cooperation in Combatting Pollution in Cases of Emergency in West and Central African Region.

5. SOUTH-EAST PACIFIC

An independent regional intergovernmental organization, the Permanent Commission of the South Pacific (CPPS), was entrusted with the implementation of the Convention and Action Plan. The Secretariat in Lima, Peru is headed by a Secretary-General who reports to the Inter-Governmental Meeting of member States of CPPS, comprising Chile, Colombia, Ecuador, Panama and Peru:

Comision Permanente del Pacifico Sur (CPPS)
Juan de la Fuente 743
San Antonio Miraflores
Apartado Postal No. 18-0046
Lima, 18
Peru
Tel: +511 444 7247 and 446 4303
Fax: +511 447 3158
E-mail: postmast@cpps.org.pe

The Secretariat administers the Action Plan for the Protection of the Marine Environment and Coastal Areas of the South-East Pacific, and carries out the provisions of the Convention for the Protection of the Marine Environment and Coastal Areas of the South East Pacific (Lima Convention), including the Agreement on Regional Cooperation in Combatting Pollution of the South-East Pacific by Hydrocarbons or Other Harmful Substances in Case of Emergency, the Supplementary Protocol to the Agreement on Regional Cooperation in Combatting Pollution of the South-East Pacific by Hydrocarbons or Other Harmful Substances, the Protocol for the Protection of the South-East Pacific Against Pollution From Land-Based Activities, the Protocol for the Conservation and Management of Protected Marine and Coastal Areas of the South-East Pacific, and the Protocol for the Protection of the South-East Pacific Against Radioactive Contamination.

6. CARIBBEAN ENVIRONMENT PROGRAMME

UNEP has been designated as the Secretariat for the Convention and Action Plan, through the Caribbean Regional Coordinating Unit (CAR/RCU) in Kingston, Jamaica, which is headed by a Coordinator:

Mr. Nelson Andrade
Coordinator
Regional Coordinating Unit for the Caribbean Environment Programme
UNEP
14-20 Port Royal Street
Kingston, Jamaica, W.I.
Tel: +1 (876) 92 292 67/8/9
Fax: +1 (876) 92 292 92
E-mail: uneprcuja@toj.com
http:/rolac.unep.mx/cepnews/

The Secretariat is responsible to the Conference of the Parties, comprising Antigua & Barbuda, Bahamas, Barbados, Belize, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, EU, France, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Netherlands, Nicaragua, Panama, St. Kitts and Nevis, St. Lucia, St. Vincent and Grenadines, Surinam, Trinidad and Tobago, United Kingdom, United States of America and Venezuela.

The Secretariat administers the Action Plan of the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, including the Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region, and the Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Area.

7. EASTERN AFRICAN REGION (EAF)

UNEP has been designated as the Secretariat under the Convention, through the Regional Coordination Unit (EAF/RCU) in Seychelles, headed by a Coordinator.

The Secretariat is responsible to the Conference of the Parties and intergovernmental meetings, comprising Comoros, EU, France, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia and United Republic of Tanzania.

The Secretariat administers the Action Plan of the Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (Nairobi Convention), including the Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region; and the Protocol Concerning Cooperation in Combating Marine Pollution in Cases of Emergency in the Eastern African Region.

8. SOUTH PACIFIC REGIONAL ENVIRONMENT PROGRAMME (SPREP)

An independent regional intergovernmental organization, the South Pacific Regional Environment Programme (SPREP), implements the SPREP Convention and other relevant conventions and action plans. The Secretariat in Apia, Western Samoa is headed by a Director who reports to the Intergovernmental Meeting of the South Pacific Regional Environment Programme (SPREP) member States, comprising Australia, Cook Islands, Federated States of Micronesia, Fiji, France, Kiribati, Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, United Kingdom, United States of America, Vanuatu and Western Samoa:

Mr. Tamarii Tutangata
Director
South Pacific Regional Environment Programme
P.O. Box 240
Apia, Western Samoa
Tel: +685 21929
Fax: +685 20231
E-mail: sprep@samoa.net

The Secretariat administers the SPREP Action Plan and the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention), including the Protocol Concerning Cooperation in Combating Pollution Emergencies in the South Pacific Region, and the Protocol for the Prevention of Pollution of the South Pacific Region by Dumping. It is also responsible for the Convention on Conservation of Nature in the South Pacific (Apia Convention) and other agreements.

9. BLACK SEA ENVIRONMENTAL PROGRAMME

An independent secretariat, the Black Sea Environmental Programme, was established to implement the Convention. The Secretariat in Istanbul, Turkey, is headed by a Coordinator who reports to the Intergovernmental Meeting of the member States, comprising Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine:

Black Sea Environmental Programme
Dolmabahce Sarayi
II. Harekat Kosku
80680 Besiktas
Istanbul, Turkey
Tel: +90 212 227-9927/8/9
Fax: +90 212 227-9933
E-mail: blacksea@dominet.in.com.tr
http://www.domi.invenis.com.tr/blacksea

The Secretariat administers the Strategic Action Plan for the Rehabilitation and Protection of the Black Sea (October 1996) and the programme of the Convention for the Protection of the Black Sea Against Pollution, including the Protocol on Protection of the Black Sea Marine Environment Against Pollution From Land-Based Sources, Protocol on Cooperation in Combating Pollution of the Black Sea Marine Environment by Oil and Other Harmful Substances in Emergency Situations, and the Protocol on the Protection of the Black Sea Marine Environment Against Pollution by Dumping.

10. EAST ASIAN SEAS (EAS)

UNEP is responsible for the East Asian Seas Action Plan, which does not have a Convention, but is guided by a regular intergovernmental meeting, the Coordinating Body on the Seas of East Asia (COBSEA), comprising Australia, Cambodia, China, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. The Regional Coordinating Unit (EAS/RCU) in Bangkok, Thailand, is headed by a Coordinator:

Regional Coordinating Unit for the East Asian Seas Action Plan
UNEP
10th Floor
United Nations Building
Rajdamnern Avenue
Bangkok 10200, Thailand
Tel: +66 2 281 2428 and 267 8007
Fax: +66 2 267 8008

The Secretariat administers the Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the East Asian Seas Region, organising the meetings of COBSEA.

11. SOUTH ASIAN SEAS

An independent regional intergovernmental organization, the South Asian Cooperative Environment Programme (SACEP), was given the responsibility to implement the Action Plan. The Secretariat in Colombo, Sri Lanka, is headed by a Director who reports to the Intergovernmental Meetings of the South Asian Cooperative Environment Programme, comprising Bangladesh, India, Maldives, Pakistan and Sri Lanka:

South Asian Cooperative Environment Programme (SACEP)
P.O. Box 1070
Colombo, Sri Lanka
Tel: +94 1 589 787 and 500 544
Fax: +94 1 589 369

The Secretariat administers the Action Plan for the Protection and Management of the Marine and Coastal Environment of the South Asian Seas Region, organising its intergovernmental meetings.

12. NORTHWEST PACIFIC REGION (NOWPAP)

UNEP serves as the Secretariat for NOWPAP, with a responsible Programme Officer in UNEP's Water Branch on an interim basis:

Water
UNEP
P.O. Box 30552
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Kenya
Tel: +254 2 62 1234
Fax: +254 2 62 2788 and 62 2798

The Secretariat is responsible to the Intergovernmental Meetings on the Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Northwest Pacific Region, which currently comprise the People's Republic of China, Japan, Republic of Korea and Russian Federation.

13. SOUTHWEST ATLANTIC REGION

The UNEP Water Branch is providing initial secretariat services in support of the development of this cooperative programme for the protection and management of the marine and coastal environment in the Southwest Atlantic region (SWAT), cooperating with the Governments of Argentina, Brazil and Uruguay, and with the coordinators of the Upper Southwest Atlantic Programme (ASOS):

Water
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14. EAST-CENTRAL PACIFIC

The UNEP Water Branch is providing initial secretariat services, cooperating with the Governments of Canada, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama and the United States of America for the further development of this regional seas programme for the protection and management of the marine and coastal environment of the East-Central Pacific, in response to the mandate given to UNEP at the 19th session of its Governing Council (1997)/

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[The Baltic Marine Environment Protection Commission and the Oslo and Paris Commissions are not formally part of the Regional Seas Programme].

ANNEX XI

WORKING DOCUMENT ON POSSIBLE COOPERATION BETWEEN C-GOOS AND LOICZ

by Jozef M. Pacyna

1. INTRODUCTION

There is a number of international organizations and research programmes studying the relationships between the atmosphere, the aquatic ecosystem, and the terrestrial ecosystem. The main goal of these programmes is to investigate the alterations of biogeochemical cycles of various chemicals in the environment due to human activities, as well as other pressure factors of natural character. These investigations include qualitative and quantitative assessment of pressure factors, such as the releases of chemicals to the air, water and land, transport of chemicals through the environment, and their effects on the environment and human health. The ocean is the ultimate recipient of these chemicals. The degree of changes of environmental pressures and their consequences on the environment and humans is of particular importance in these studies, together with the development of future scenarios for these changes under various conditions related to macroeconomic change in the world, socio-cultural factors and public opinion. The above mentioned studies are being carried out at a local, regional (e.g. continental), and global scale.

The IGBP Land-Ocean Interactions in the Coastal Zone (LOICZ) and the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (C-GOOS) are two examples of programmes engaged in understanding the nature of interaction between the ocean, the atmosphere, and terrestrial ecosystem. Although the scientific interest of both programmes is very similar, the issues and approaches of exploring this interest are different. LOICZ focuses on research projects aiming at the assessment of local, regional, and global changes of material fluxes and their environmental effects in the coastal zone through studying the dynamics and kinetics of these changes and biological, physical, chemical, and hydrological mechanisms of interactions between the ocean and other ecosystems. C-GOOS focuses on monitoring/ measuring the changes of chemicals resulting from these interactions over a period of time. Thus, the approaches of LOICZ and C-GOOS are quite complementary in improving our understanding of the role of the ocean in global change of the environment and the effects of this change on the ocean.

2. THE OBJECTIVES OF THE WORKING DOCUMENT

The main goal of the Working Document is to investigate the potential for cooperation and complementary activities between LOICZ and C-GOOS in order to improve our understanding of interactions between the ocean, the atmosphere, and terrestrial ecosystem at regional to global scale, and to propose joint activities, e.g. joint assessments of changes in cycling of chemicals (materials) in the coastal zone.

The above mentioned goal will be achieved through the following tasks:

- review of LOICZ and C-GOOS scientific objectives, definitions of the study problems, work structures, and science and implementation plans,

- definition of functional categories of coastal systems and the regions of priority in studying the changes in the coastal zone, and

- elaboration of a list of activities which will contribute to better fulfilment of tasks and goals of both programmes.

3. HOW CLOSE ARE THE SCIENTIFIC GOALS AND TASKS OF LOICZ AND C-GOOS?

The goals of LOICZ as stated in the Science Plan of the programme are:

- to determine at global and regional scales: (a) the fluxes of material between land, sea, and the atmosphere through the coastal zone, (b) the capacity of coastal systems to transfer and store particulate and dissolved matter, and (c) the effects of changes in external forcing conditions on the structure and functioning of coastal ecosystems,

- to determine how changes in land use, climate, sea level, and human activities alter the fluxes and retention of particulate matter in the coastal zone, and affect coastal morphodynamics,

- to determine how changes in coastal systems, including responses to varying terrestrial and oceanic inputs of organic matter and nutrients, will affect the global carbon cycle and the trace gas composition of the atmosphere, and

- to assess how responses of coastal systems to global change will affect the habitation and usage by humans of coastal environments, and to develop further the scientific and socio-economic bases for the integrated management of the coastal environment.

The research foci and activities of LOICZ and their relationship to those outlined in the LOICZ Science Plan are the following:

- the effects of changes in external forcing or boundary conditions on coastal fluxes, with activities on: (a) catchment basin dynamics and delivery, (b) atmospheric inputs to the coastal zone, (c) exchanges of energy and matter at the shelf edge, and (d) development of coupled models for coastal systems. These activities are linked to IGBP cross-cutting projects adding to the "land element of LOICZ", especially through the Continental Aquatic Systems project,

- coastal biogeomorphology and global change, with activities on: (a) the role of ecosystems on determining coastal morphodynamics under varying environmental conditions, (b) coastal biogeomorphological responses to anthropogenic activities, and (c) reconstruction and prediction of coastal zone evolution as a consequence of global change. Major activities focus on developing and implementing a practical and effective typology (ies) approach, and building further specific data sets to complement LOICZ current ones. This will provide a global perspective and assist in up-scaling the processes and flux information,

- carbon fluxes and trace gas emissions, with activities on: (a) cycling of organic matter within coastal systems, (b) estimation of net fluxes of N2O and CH4 in the coastal zone, and (c) estimation of global coastal emissions of dimethyl sulfide. The organic matter activity is the major priority at this stage, and

- economic and social impacts of global change in coastal systems, with activities on: (a) evolution of coastal systems under different scenarios of global change, (b) effects of changes to coastal systems on social and economic activities, and (c) development of improved strategies for the management of coastal resources.

Currently the LOICZ work plan is being revised by the LOICZ Executive Committee with the aim to further develop the work plan for the 5 year period from 1998 through 2002. This work plan focusses on an integrated programme of material fluxes in/between coastal basins, coastal seas and boundary fluxes with atmosphere and continental slopes. The emphasis is on C, N, P (particularly CO_2) and dissolved, particulate states/forms of the materials. The socio-economic dimension is important; the effect of people activities on the material fluxes and how the subsequent changes in the coastal zone may influence the human dimension of the coastal zone. The modeling approach will use the "currencies" of biophysics (especially carbon, energy) and the monetary values of changes and influences.

Fundamental to LOICZ approach is the recognition for local, regional and global scale assessments that the coastal zone is not a simple "line boundary" but is a global "compartment" with special and characteristic features. In addition, it is recognized that there is a huge amount of existing and recorded data and work being done around the globe on coastal habitats at a variety of scales (and that there are gaps in this work). Hence, LOICZ plans to continue to network and integrate the expertise and information at these levels into delivering science knowledge to address LOICZ regional and global questions. LOICZ particularly provides a forum and mechanism for this integration to deliver relevant science knowledge (to the LOICZ data users, e.g. NGO, IGO, national coastal zone managers and decision makers, and the wider science and general community).

The development of nutrient budgets at local and regional scales for coastal seas including flux boundary conditions at landward estuarine environments and continental margins environments, is a core activity. Allied river basins work is to elucidate the material input conditions and processes, including the socio-economic effects and conditions, to be closely linked with the coastal sea material budgets. Work with JGOFS (through our joint Continental Margins Task Team) is focussed on the flux boundary evaluation of linkage to the oceans across the continental slope.

In addition to the biophysical and socio-economic dimensions and assessments of horizontal material fluxes, the scaling issues and methodological developments are crucial to LOICZ. There is a strong involvement of researchers at local scales. Through the development of typology approaches, tools and methods LOICZ will try to find a coherent approach to the up-scaling issue.

C-GOOS goals are to link monitoring (measurement, observation) programme needs and products to the needs and products that are beneficial to society and various groups of users working in the coastal zone. Therefore, the C-GOOS objectives include:

1. Determination of user needs in the coastal zone and specification of the environmental data and products required to satisfy these needs.

2. Identification of regions where current monitoring efforts are inadequate and formulation of plans to fill these gaps.

3. Identification of inadequacies in the measurement programmes of current observation systems in terms of the variables measured, the scales on which they are measured, and their usefulness.

4. Promotion of regional to global coordination and integration of monitoring and modeling.

5. Promotion of the design and implementation of internationally coordinated strategies for data acquisition, integration, synthesis, and dissemination of products.

6. Promotion of the use of regional and global networks to improve now-casting, forecasting and prediction of environmental change in the coastal zone.

C-GOOS is now working on formulation of strategic and implementation plans for achieving the above goals.

As seen from the above, the goals of LOICZ and C-GOOS complement each other in meeting the overall goal of better understanding: (a) the interactions between the ocean, the atmosphere, and the terrestrial environment, (b) the pressures affecting these interactions, particularly the impact of human activities, (c) the consequences of these interactions, and (d) the cost-efficient possibilities to reduce these interactions.

Both, LOICZ and C-GOOS operate on local, regional, and global scales with respect to the definition of pressure factors, the monitoring/ modeling of the state of the aquatic environment, and the assessment of consequences of pressure factors on the environment. Locally defined pressures in the coastal zone may have consequences on a global environment.

4. WHAT ARE THE PRACTICAL WAYS FOR C-GOOS TO COMPLEMENT THE ACTIVITIES OF LOICZ?

A review of certain aspects of scope of both programmes, as well as certain terms of habitat characteristics, and factors used for comparative analysis of systems studied within the programmes needs to be carried out in order to address the above mentioned question. This review can be made using the LOICZ research plan, as well as the LOICZ Strategy and Work Plan 1998-2002, presently under development.

LOICZ projects encompass both the land margin to an approximate altitude of 200 m above sea level and the coastal waters out to the edge of the continental shelves, approximately matching the region that has been alternatively flooded and exposed during the sea level fluctuations of the late Quarterly period. Thus, the coastal domain within LOICZ varies from 200 m above to 200 m below sea level.

4.1. DEFINITION OF FUNCTIONAL CATEGORIES OF COASTAL SYSTEMS IN LOICZ

Organic production and the transformation of nutrients, carbon, pollutants and sediments in, and their transport through coastal systems are strongly influenced by physical and chemical forcing at the land, ocean, and atmosphere boundaries. This forcing is directly related to functional categories of coastal systems. LOICZ considers several functional categories which have a direct impact on the degree of environmental pressures. The following impact categories are generally defined within the LOICZ projects:

- tourism (recreation),
- fresh water supplies,
- fishing/ aquaculture,
- coastal residences,
- commercial/ industrial buildings, ports, etc,
- coastal ecosystems and wetlands, and

- agriculture.

Typologies approaches and modeling tools for integrated assessment of human and environmental dimensions are yielding new tools and address these "people" and physico-chemical interplays at regional and global scales. LOICZ and C-GOOS are envisaged as partners in development and applications of the typology approach and "people"/environment assessment models currently being evolved by LOICZ.

On-site and off-site linkages are usually found to be involved in the pressures on the coastal zone resources. The major linkages include:

- urban sprawl and industrial and tourism development,
- pollution from riverain, airborne, and marine sources,
- channelization of the lowland sections of rivers and upstream diversion of rivers leading to beach loss and replenishment requirements,
- waste disposal in excess of assimilative capacities and posing human health risk,
- loss of coastal habitats, such as coral reefs, wetlands, and dune complexes,
- over fishing,
- sand and gravel mining, and
- oil and gas exploitation and transport leading to shoreline loss and pollution.

The context for these pressures and other linkages has recently been addressed by LOICZ (Towards integrated modeling and analysis in coastal zone: principles and practice, R.K. Turner, W.N. Adger and I. Lorenzoni, LOICZ Reports and Studies No. 11, in press).

The environmental change in the coastal zone is defined as a function of or in a form of:

- the rate of population growth and economic development,
- the rate of degradation of natural resources,
- the rate of coastline modification resulting in dynamic changes, including barrier and near shore islands,
- the rate of decline of biological productivity and biological diversity,
- increasing exposure of coastal populations to natural and anthropogenic hazards,
- increasing risk over utilization of sink assimilative capacity because of extensive links to "upstream" human activities,
- declining management effectiveness resulting from complexes related to the problem of coordination between different management regimes for marine and land resources, and
- vulnerability to potential climate change effects, including accelerated sea level rise.

The effects of changes in external forcing related to the functional categories of coastal systems mentioned above on coastal fluxes are a subject of studies within Focus 1 (Coastal Basins) and the collaborative activities of Focus 4 (Human Dimensions) of LOICZ.

4.2. DEFINITION OF DATA NEEDS WITHIN LOICZ

The aims of LOICZ in terms of global and regional synopses and forecasts can be translated into a combination of specific measurements and model data required to meet these aims. Indeed, a vast spectrum of measurements, observations, models, documents, and other types of data at a variety of scales is needed in order to meet the LOICZ goals. The data (collected in-situ, remotely sensed and from models) and the information needed for LOICZ would cover many different types and various spatial and temporal scales. These data are being collected and stored in accordance with the guidelines of the LOICZ Data and Information System (LDIS).

The following examples can be given for required data types and preferred temporal scales based upon the requirements identified by the LOICZ Implementation Plan:

- terrestrial data: from seasonal to interannual (land cover and use, soil map, coastal morphology, hydrological data, river runoff, geology, geophysics, etc.),

- marine data: from yearly, for slow processes, up to twice daily, for processes changing with tides (waves, current, tide, temperature, productivity, bathymetry, biology, chemistry, pollution, etc.),

- atmospheric data: from seasonal to daily (wind, temperature, humidity, cloud cover, chemistry, etc.),

- infrastructure data: yearly (location and characteristics of population centres, commercial ports, marinas, agriculture plants, industrial complexes, etc.), and

- socio-economic data: yearly (population density and composition, means of living, income per capita, market prices, etc.).

A list of required variables for LOICZ includes 187 variables and is presented in LDIS Plan (LOICZ Reports and Studies No. 6, 1996). The list is presented in Annex 1 after the LDIS Plan.

C-GOOS may contribute to the LDIS data base with information from the measurement/ monitoring networks which would be established with the C-GOOS help. On the other hand, C-GOOS may use the LDIS data base when identifying inadequacies in the measurement programmes of current observation systems in terms of variables measured, the scales of which they are measured, and their usefulness (Objective No. 3 of the C-GOOS). Indeed, there is a great need for frequent and continuous consultation between LOICZ and C-GOOS when planning and then launching new projects/ measurement networks with respect to the availability of information on parameters to be measured/ monitored and the need for further measurements/ monitoring. A liaison unit between the C-GOOS and LOICZ can be established to carry out this consultation.

Another important task of such liason would be to contribute to the assessment of results of LOICZ as a whole programme and its individual projects/ case studies. Such assessments, carried out at the end of certain period of LOICZ operation are quite necessary in order to conclude on the state of the marine environment and to plan further activities. The C-GOOS experience may be considered by LOICZ when concluding on the work being performed and planning future activities.

4.3. MODELING DATA NEEDS WITHIN LOICZ

One of the long term objectives of LOICZ is to develop improved numerical models that describe the dynamics of biogeochemically important elements in the coastal zone at regional and global scales. The development of common and consistent modeling approaches is needed in order to produce outputs at the local scale. These outputs shall then be integrated into larger scale regional synthesis. The main priority of LOICZ modeling is to develop carbon, nitrogen, and phosphorus (CNP) models in the coastal zone. Special guidelines have been developed within LOICZ on how to develop biogeochemical models within the programme (LOICZ Biogeochemical Modeling Guidelines, LOICZ Reports & Studies No.5, 1966). In general, these guidelines outline biogeochemical modeling methodologies which shall help to promote the collection and analysis of necessary data, and resolve these issues.

The models are aquatic models that include water, sediment and nutrients, as well as various forms of carbon. They include internal dynamics as well as important exchanges across landward and seaward boundaries. Three spatial scales, defined in terms of linear coastline length, have been identified in the LOICZ Implementation Plan as being of primary interest to LOICZ. They are:

- local/ site scale (~1-100 km): these would address specific habitats, such as saltmarshes, mangrove forests, deltas, coral reefs, estuaries, bays, and fishing banks. It is intended to develop these models in such a way that they can be applied to several sites with similar conditions,

- regional scale (~100-10,000 km): these would incorporate a variety of near-shore and off-shore habitats, in some cases out to the 200 m isobath. Modeling on this scale would be geographic in nature and would be carried out for a particular region of the world, such as the North Sea, South China Sea, etc., and

- global scale: these would incorporate several regional models representing either the entire world's coastal zone or a substantial proportion, based on representative regions, the results from which are up-scaled to the global scale.

Models would also differ with respect to temporal scales depending on their particular purpose. In general, in order to study multi-year phenomena it is necessary for LOICZ models to resolve seasonal cycles, annual cycles, and directional cycles. The initial LOICZ priority is on the estimation of the present fluxes of carbon, nitrogen and phosphorus in particular coastal systems on the local scale.

One of the most important steps in developing and application of models is their verification/ validation through a comparison with data from monitoring networks and/or specific measurement campaigns. It is anticipated that LOICZ and C-GOOS will find common interests in cooperating in preparation of measured data sets for validation purposes. C-GOOS may identify regions where current monitoring efforts are missing or inadequate for validation of LOICZ models and formulate plans to establish such measurements/ monitoring networks to fill the gaps (Objective No. 2 of C-GOOS).

Details on the modeling guidelines with the description of case studies of budget estimates in Bahia San Quintin, Mexico, Klong Lad Khao, Thailand, Tomales Bay, California, Gulf of Bothnia, the Baltic-Kattegat System, Spencer Gulf, Australia, Tokyo Bay, Japan, and East China Sea are presented in LOICZ Reports and Studies No.5.

Further discussion on budgets for Mexican coastal lagoons, including lagoons in arid Pacific and Gulf of California coasts, humid Pacific Coast and Gulf of Mexico is presented in a document on Comparison of Carbon, Nitrogen and Phosphorus Fluxes in Mexican Coastal Lagoons (LOICZ Reports & Studies No. 10, 1997).

A preliminary discussion on question whether coastal seas are a net source or sink of CO_2 to the atmosphere is presented in a LOICZ document on Coastal Seas: A net source or Sink of Atmospheric Carbon Dioxide? (LOICZ Reports & Studies No. 1, 1995). Obviously, this very important question is also very difficult to answer. Taking into account riverine discharge of organic carbon and total sedimentation, it was suggested that coastal seas should be net heterotrophic, that is they release more CO_2 to the atmosphere than they take up. To dates, the accuracy of estimates of riverine carbon discharge and carbon burial in sediments is inadequate (see the discussion during the Kyoto meeting on reductions of greenhouse gas emissions in December 1997). C-GOOS in cooperation with LOICZ may consider the promotion and design of internationally coordinated strategies for data acquisition, integration, and synthesis with respect to riverine discharge of organic carbon and total marine sedimentation (Objective No. 5 of C-GOOS).

5. C-GOOS AS A MODULE BASED ON A GLOBAL DATA ACQUISITION NETWORK

C-GOOS has been established to address issues on global scale. However, many problems in the coastal zone are especially severe in certain regions, located often in developing countries. These local problems may well have a global impact. Therefore, if the C-GOOS is realized in a global sense, all the world's coastal regions must be considered in detail, with their local, regional, and global peculiarities. However, it is essential that the locally implemented constituents of a global GOOS are consistent with a global perspective 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.

Case studies/ projects carried out on local and regional scale within LOICZ may provide a body of information which can be used in regional to global networks to improve now-casting, forecasting, and prediction of environmental change in the coastal zone. C-GOOS aims at the promotion of the use of such networks (Objective No. 6 of C-GOOS) and therefore is envisaged to be a vital "broker" in working with LOICZ in transferring the LOICZ data to such networks. LOICZ data meet the requirements of consistency with respect to a global perspective demands.

The EU European Land-Ocean Interaction Studies (ELOISE) programme shall also be a partner for cooperation with C-GOOS with respect to the promotion of the design and implementation of internationally coordinated strategies for data acquisition, integration, synthesis and dissemination of products (Objective No.5 of C-GOOS) and the promotion of the use of regional to global networks to improve now-casting, forecasting, and prediction of environmental change in coastal zone (Objective No.6 of C-GOOS). ELOISE, consisting of 29 research projects is regarded as a European contribution to LOICZ. The overall goal of ELOISE is to determine the role of coastal seas in land-ocean interactions (including shelf-deep sea interactions along the shelf edge) in perspective of global change. This goal should be achieved through the assessments of the ELOISE project results within three ELOISE working groups on: (1) Biogeochemical Fluxes and Cycling, (2) Ecosystem Structures, and (3) Modeling and Data Management. After two years in operation, ELOISE projects produce now a great number of data based on measurements and modeling carried out in wide range of geographical coverage and various time scales. Some of the projects deal with measurements in small estuary systems, the other projects study the open sea systems. Obviously, the hydrology of one sea may differ from the hydrology of another sea making the integration of data from both regions rather difficult. Thus, one of the major problems within ELOISE is the data integration from various projects. C-GOOS may consider the subject of data integration as a priority area in further activities within its Objective 5 on the promotion of the implementation of internationally coordinated strategies for data collection, integration, and dissemination. ELOISE is expected to be an active and vital partner with C-GOOS addressing these issues.

Another subject for further consideration of C-GOOS is whether the results from projects carried out within one programme, (e.g. ELOISE) can be applied by users other than scientists within or outside this programme community, e.g. by decision making, environmental management and/or planning, or even industry located in coastal zone (fishery, transport, tourism, water supplies, etc). This touches the strategic question of the mid- to long-term exploitation of research results in a view of economic development (e.g., wider economic impacts), and social objectives (e.g., impacts on the quality of life, employment, and skills, on the environment and its resources, etc) of the respective programmes. The above subject is related to the C-GOOS Objective No.1 on the promotion of user needs in the coastal zone and the specification of the environmental data and products required to satisfy these needs.

6. FINAL REMARKS

It is anticipated that LOICZ and C-GOOS will find common interests in cooperating in order to better understand various physical, chemical, biological and hydrological processes and their consequences on the state of the environment in the coastal zone on a local, regional, and global scale. Liaison mechanisms between the LOICZ and C-GOOS can be established to carry out consultation on cooperation within promotion and development of various measurement and modeling activities within the programmes.

C-GOOS is envisaged to be a vital "broker" in working with LOICZ in transferring the LOICZ data to global networks aiming at the improvement of now-casting, forecasting and prediction of environmental change in coastal zone (Objective 6 of C-GOOS). LOICZ and C-GOOS will encourage joint activities in regional coastal seas in order to provide a body of information for the global networks.

It is anticipated that LOICZ and C-GOOS will find common interests in cooperating in preparation of measured data sets for validation of LOICZ model results. C-GOOS may identify regions where current monitoring efforts are missing or inadequate for validation of LOICZ models and formulate plans to establish such measurements/monitoring networks to fill the gaps (Objective 2 of C-GOOS).

C-GOOS may consider the subject of data integration as a priority area in further activities within its Objective 5 on the promotion of the implementation of internationally coordinated strategies for data collection, integration, and dissemination. The EU ELOISE programme, the European contribution to LOICZ is anticipated to be an active and vital partner with C-GOOS addressing this issue.

Finally, any duplication of efforts within LOICZ and C-GOOS shall be avoided.

ANNEX 1. REQUIRED VARIABLES FOR LOICZ AND POTENTIAL SOURCES.

VARIABLE	SOURCE
accretion rates in mangrove	FAO, UNEP
administrative/legislative/institutional context	Worldbank
air-sea CO_2 exchange	JGOFS, WMO, ECMWF
alkalinity	IODE
along coast boundary exchange	IODE
amount of fine/coarse suspended river sediment	IHP, FAO
aquaculture sites	FAO
areal extent of habitat types	FAO, ETI
aridity	IHP
atmosphere deposition	IGAC, WMO, EEA
atmosphere terrestrial/fresh water fluxes	BAHC, WMO, EEA
basin wide circulation	IODE
bathymetry/bottom topography	GEBCO
below ground biomass	FAO
biodiversity	UNESCO/ETI
biogeochemical cycling	FAO
biogeochemical processes	FAO
biological production	FAO
biomass burning	LUCC, FAO, UNEP
C - dissolved organic fractions carbon	WMO
carbon in coastal waters	ICES, IODE
catchment area	IHP
CH_4	
chemical attributes of river borne C, N, P	GEMS, IHP, FAO
chemical contaminants - assimilation capacity	GEMS, IODE
chemical controls of C, N, P river movements	IHP, FAO
chlorophyll	FAO, ICES, NOAA
climate	WMO
climate fields	WMO, ECMWF
climatic variables	WMO, ECMWF
climatic zonation	WMO
CO_2	
coastal erosion - terrigenous inputs	EEA
coastal zone colour	NOAA, ESRIN, JRC
concentration of DOC in coastal water	ICES, IODE
coral reef accumulation	FAO, UNEP, ICLARM
coral reef community structure	FAO, UNEP, ICLARM
coral reef export	FAO, UNEP, ICLARM
coral reef production	FAO, ICLARM
cultural diversity and rate of change	Worldbank
currents	IODE
demographic characteristics	Worldbank, SEDA
development indicator	Worldbank
dimethylsulphide (DMS)	
distribution of DOC in coastal water	ICES, IODE
DOC - Dissolved organic carbon	IODE

VARIABLE	SOURCE
economic and social features	Worldbank
economic potential	Worldbank
ecosystem response to anthropogenic change	Worldbank, GCTE
endogenous sediments - supply, retention, ...	
environmental quality	EEA, UNEP
erosion - shore & bottom	FAO
erosion rates	FAO, EEA
exchanges at the shelf edge	ICES, IODE, JGOFS
fertiliser use	LUCC, FAO
fisheries production	FAO, ICES
flocculation rate in river	IHP, FAO
flushing	IODE
fluxes between neighbouring coastal regions	ICES, IODE
food chain dynamics	FAO
forestry species and size class	FAO
freshwater runoff	IHP, FAO, BAHC
geology	WDC
geomorphology	WDC
groundwater	IHP
groundwater discharge	WMO, FAO, IHP
habitat type information	FAO, ETI
heavy metals	GEMS, IODE
high resolution photographic images	NOAA
human use & disturbance	UNEP
hydrological processes	IHP
hydrology	IHP
indicator of dependence on coast	Worldbank
inorganic C (concentration) in sediments	
land cover	LUCC, FAO, EEA, UNEP
land use	LUCC, FAO, EEA, EROS, NOAA, SPOT
level of welfare indicator	Worldbank
levels of primary production	FAO
litter fall	
local Redfield ratios	
mangrove distribution	UNEP, ETI
mangrove Forest above ground biomass	FAO, UNEP
mangrove primary production	FAO, UNEP
mean rainfall	WMO
mean temperature	WMO, ECMWF
measure of "naturalness"	
monthly maps of carbon sink/source	
N - dissolved nutrients in coastal water	ICES, IODE
N - dissolved organic fractions	
N_2O	
nephelometers	IODE
NH_4 - dissolved nutrients in coastal waters	ICES, IODE
nitrate input from rain	WMO, UNEP, IHP
nitrogen	
nitrogen in coastal water	ICES, IODE
nutrient cycling	
nutrient input	FAO
nutrients	ICES, IODE
nutrients - assimilation capacity	

VARIABLE	SOURCE
organic C (concentration) in sediments	
organic carbon	
organic carbon - assimilation capacity	
P	
P - dissolved nutrients in coastal water	ICES, IODE
P - dissolved organic fractions	
palaeography	PAGES
palaeographic reconstruction	PAGES
pCO_2	
pCO_2 - free dissolved CO_2	IODE
pH	IODE
phenology tree density and latitude	FAO, UNEP
photosynthesis	
photosynthesis rate in water column	
physical controls of C, N, P river movements	IHP, FAO
POC - Particulate Organic Carbon	IODE
pollution	IODE
pollution monitoring	IOC/IODE
population growth rates	Worldbank, CIESIN
population size	Worldbank, CIESIN
Q - river discharge	IHP, FAO, GLORI, BAHC
quantity of river borne C, N, P	IHP, FAO
rate of change of climate	WMO
ratio of CZ importance to overall national economy	Worldbank
reef distribution	FAO, UNEP, ICLARM
remineralisation rate of organic C	
respiration	
respiration rate in water column	
river C, N, P	IHP, FAO
river total dissolved solids	IHP, FAO
river-estuary-shelf fluxes	EEA, JGOFS
salinity	IODE
saltmarsh distribution	UNEP
sea level	IODE, GLOSS, TOPEX
sea surface temperature	IODE, NOAA
seabed sediment characteristics	ICES, IODE
seagrass distribution	FAO, UNEP, ETI
seasonality of DOC	
sediment	ICES, IODE
sediment accumulation	
sediment delivery of rivers	IHP, GLORI
sediment input	IHP, FAO, GLORI
sediment loading	IHP, UNEP
sediment trap data	ICES, IODE
sedimentation rates	
sediments - total suspended matter (concentration)	ICES, IODE, GLORI
sensitivity of coastal ecosystems	UNEP
shelf width	GEBCO
shoreline configuration	UNEP
silicon/silicate	
snow cover	WMO
soil variables	FAO
soil types	FAO
soils	EEA, FAO
species and associations	ETI
subsidence rates	GLOSS

VARIABLE	SOURCE
surface ozone concentrations	WMO, ECMWF
suspended matter	ICES, IODE
suspended matter - (concentration)	ICES, IODE
suspended matter - chlorophyll	ICES, IODE
suspended matter - inorganic C concentration	
suspended matter - POC concentration	ICES, IODE
suspended sediment	ICES, IODE
synthetic organic compounds	
tidal measurements	IODE
tidal range	IODE
tidal regime	IODE
tide	IODE
timing sequences for river borne C, N, P	IHP, FAO
topography	UNEP
total inorganic dissolved C	
total sediment transport	IHP, FAO
tourist carrying capacity	Worldbank
tourist density	
trace gas emission	WMO
trace metals	ICES, IODE
tributary chemistry	BAHC
tributary hydrology	IHP, FAO
TSS - total suspended sediments	IODE (marine), GLORI (river)
turbidity	IODE
type of seasonal boundary conditions	WMO, IODE
vegetation	FAO
vertical particle flux	IODE
waste water inputs	FAO, UNEP, IHP
water temperature	IODE
wave dominance	IODE
wetlands	UNEP, ETI

ANNEX XII

PRINCIPLES OF GOOS CAPACITY BUILDING
(Version 3.0 by Worth Nowlin)

A DEFINITION OF CAPACITY BUILDING

Recognizing that many coastal states lack the capabilities in marine science required for them to fully participate in, contribute to, or benefit from the effective planning, establishment and coordination of an operational global ocean observing system to provide the information needed for oceanic and atmospheric forecasting, for ocean and coastal zone management by coastal nations and for global environmental change research, the IOC/GOOS is developing principles and a programme to develop national capabilities in marine sciences and services. This programme for the building of capacity involves a wide range of activities, depending on the starting capacity (level of ability) of the nation concerned. The activities fall under the general headings of training, education, and mutual assistance; within the IOC they are managed through the TEMA programme, which includes technology transfer. A first step in building capacity is raising awareness of the activities involved, the benefits that may accrue from participation, and the likely costs. The building of capacity of all countries to participate in and benefit from GOOS on a continuing basis is regarded as essential for the effective development of a continuing global ocean observing system. (A definition covering all of the IOC themes is given as Annex A.)

CAPACITY BUILDING OBJECTIVES

In the OECD (Organisation for Economic Cooperation and Development) countries, the existing infrastructure will underpin many of GOOS activities. This is not true for many nations, where the necessary infrastructure is only partly or poorly developed. Where such infrastructure does not exist, strategies should be implemented to meet the following needs of nations:

- The need for ocean data, including satellite measurements and *in situ* measurements necessary for their calibration and validation. (Special efforts should be made to create and sustain an onshore and offshore baseline network of high quality surface-based stations or sections in a wide range of climates; many of these are likely to be in nations requiring assistance or in their Exclusive Economic Zones offshore.)

- The need to raise the ability of nations to contribute to and benefit from global observing systems. The goal is capacity building for sustainable development. There must be a long-term investment in facilities for receiving, processing, and interpreting data from ocean and space-based sources--to be accompanied by training in the use of such facilities and in the provision of services and products. (Services and products are likely to relate to seasonal predictions, drought and severe storm monitoring, sea level rise, regional climate change, coastal zone and fisheries management, coastal protection, coastal pollution, harmful algal blooms, coral reef disturbance and recovery and the like.)

- The need to raise understanding of the value of *in-situ* and space-based observations of the ocean to solving socioeconomic problems of states requiring assistance. Efforts must be made to educate the public and politicians regarding the benefits to be obtained from investing in developing, maintaining, and utilizing ocean observation systems in support of sustainable development.

Examples of actions required to meet these objectives are included in Annex B.

CAPACITY BUILDING IS A PARTNERSHIP

GOOS capacity building is carried out by three partners: (1) the recipients, or local beneficiaries of the activities; (2) the donor agencies or nations; and (3) the GOOS organization with its sponsors.

Effective capacity building is a long-term process which starts with the potential users and their needs. Capacity building partnerships may focus upon one country, or a group of neighboring countries sharing similar problems. They may involve bi-lateral or multi-lateral relationships and partnerships. The underlying implication is that the interests and commitments of all partners must be considered prior to taking actions. GOOS capacity building activities should be harmonized to the extent possible with those of other entities, including organizations and states interested in the region. A major part of the financial support must come from agencies/states located or interested in the region.

Efforts to build capacity should maximize the use of existing skills and resources, and ensure that the end of a project is not the end of the road. The real challenge in capacity building is to go beyond the transfer of funds, equipment, and knowledge to the point of sustainable development. It must be recognized that an adequate institutional framework is required--a framework grounded in strong relations between competent organizations that together will form a national global observing system working group striving to create services and products of value to local decision makers as well as useful globally.

For each partnership a plan is needed that identifies the needs of the user region, the requirements for GOOS implementation in the region, the capacity building needs related to that implementation, and sources of funding support. Regional representatives should be involved in developing all elements of this plan. An IOC/GOOS coordinator is needed to ensure coordination of TEMA objectives and advice from technical experts and GOOS panels into the process of implementing the plan and for continuity.

CONTINUITY IS REQUIRED

It is critical that capacity building activities are pursued in a manner that ensures capacity is sustained, either through continuing effort or through series of well-targeted, short-term activities. Plans and resources must be in place to enable follow up activities prior to holding workshops to build awareness. The capability to deliver assistance must be in place before building expectations of the recipients. It is important that individuals delivering capacity building assistance be part of an active network with broader participation and access to portable resources compatible with local needs. There are clear advantages if an individual who is performing well in a regional office remains in the position long term; new individuals must establish local contacts, gain the confidence of those in the region, and generally learn idiosyncrasies of the area. The counterpoint is that safeguards are required to ensure that such individuals continue to perform well.

The multi-year plan for each regional GOOS capacity building activity should include a logical progression of activities enabling regional users to contribute to GOOS development and use the resulting data and products. This plan should be presented to potential donors interested in supporting the goals of GOOS as mandated by UNCED, AGENDA 21, and other pertinent conventions.

IMPORTANCE OF LOCAL FOCI

Capacity building is most effective when the region is entrained as a provider, not just as a recipient. For example, local people "on the ground" should be entrained into the planning and, if at all possible, execution of the activities. Training and support delivered outside the region are less effective. If possible, regional offices should be staffed or augmented with individuals from the region. It is important to circumscribe the area of responsibility for a regional office to avoid over commitment and false expectations. It is important to network with regional institutions and pertinent operational agencies.

GOOS will continue to evolve. Local offices will help to sustain the capacity building activity by assisting with continuing upgrades of new communications, models, sampling technology, products, and other needs.

Regional organizations (e.g., SOPAC) already having operational responsibilities should be fully utilized by the GOOS system because it is imperative to have access to staff, support systems, communications, data facilities, and other infrastructure-particularly in regions lacking such capabilities on national bases.

It is recommended that nations consider the creation of National GOOS Steering Committees in which all of the key stakeholders (government departments, private sectors, and academic institutions) are brought together to define the user needs and find ways of meeting them. National GOOS Steering Committees might be expected to:

- Define user needs and specify data and products required to satisfy those needs.
- Identify and suggest improvements to existing national capabilities.
- Identify gaps in those capabilities and suggest corrections, including training and practical assistance as well as gap filling.
- Promote communication among marine scientists, environmentalists, and coastal zone managers.
- Encourage design and implementation of regional strategies for data acquisition, communication, synthesis, and dissemination of needed products.
- Encourage pilot projects to demonstrate the usefulness of the GOOS approach.
- Evaluate costs and benefits as a basis for persuading governments, donor agencies, and the private sector to support GOOS initiatives.

TECHNICAL EXPERTISE IS REQUIRED

GOOS capacity building activities must maintain close links to the scientific and technical design of GOOS, and be aware of other scientific and technical activities related to GOOS, such as the research programmes of the WCRP and IGBP. GOOS technical experts may be needed locally only for limited periods, although local continuity and coordination must be maintained, as mentioned elsewhere. These technical experts must draw upon and train local expertise whenever possible. GOOS must adopt the principle that those expert teachers are teaching new teachers; only in this way can the process be successfully self-sustaining. Materials and approaches must be designed accordingly, and if possible have application to more than one region.

OPERATIONAL OR MARINE-RELATED BASES OF OPERATION

Institutions and organizations with the competence to participate in GOOS frequently exist in nations needing assistance; often they lack connection to the institutional framework of GOOS. Integration of the various participants and organizations into the institutional framework must take place to ensure that local expertise is harnessed, work programmes are defined, information is exchanged, decisions are taken, results emerge, and capacities are built.

To this end regional offices for GOOS capacity building should be co-located with an operational or marine-related activity when practicable. The activity might be the secretariat for a regional marine body (e.g., WESTPAC) or an operational oceanographic or meteorological activity providing data, products, services (e.g., a national weather service office). Again, care should be exercised to ensure the operational office can work closely with other regional marine science/operations activities.

To take matters forward, organizations should be chosen according to their proven expertise, their modus operandi, and their capacity for working with others; they may include governmental and intergovernmental bodies, universities, research centers, NGOs or private companies. The institutional relationships between them must be based on confidence and driven by a common sense of purpose as expressed in a jointly negotiated agreement.

UTILIZING THE GOOS SPONSORSHIP

Remembering that GOOS has many sponsors, GOOS capacity building activities are expected to be supported in part by the capacity building capability of all of these partners. It is extremely important that TEMA support be available for GOOS capacity building on behalf of the IOC as a sponsor. Likewise, it is crucial that the capacity building resources and capacity of other GOOS sponsor be utilized.

The first financial commitment should come from the region. It may be small, but it represents a political commitment that can be built upon. Other GOOS sponsors should be a part of the planning process that decides on capacity building plans for the region. It should be expected that regional programmes would share in the support of such activities and contribute their voices to approaching donors. (Funding may come through national or international aid agencies such as the Global Environmental Facility of the World Bank. Here it is important to remember that it is the developing states themselves who have to bid for resources. Thus the GOOS role is one of a facilitator to bring together countries to address ocean and coastal issues, and to work with them to realize the results of their decisions. One important facet of capacity building is the provision of advice on how to construct fundable proposals; another is helping to raise awareness in local policy makers that environmental observations deserve to be high on the list of national concerns.)

GOOS CAPACITY BUILDING PANEL

To provide guidance regarding user needs in the development of GOOS, and to communicate GOOS plans and common requirements to users, a strong and continuing link must be maintained between the GOOS Steering Committee and GOOS capacity building activities. It is suggested that the GOOS Capacity Building Panel be constituted as a resources and steering committee with the following membership: one representative from each GOOS module design panel, representation from the GOOS Steering Committee (including representation of countries needing assistance), and an independent chair. This GOOS Capacity Building Panel would report to the GOOS Steering Committee and through that committee to the I-GOOS.

Ex officio membership on the Panel should include that person at the IOC/GOOS Office with overall responsibility for GOOS capacity building and a representative of TEMA (who may be the same person representing the Office). Representatives of donor foundations should be invited to the Panel meetings.

CONNECTIONS BETWEEN GLOBAL OBSERVING SYSTEMS

It should be remembered that many capacity building activities are undertaken on behalf of GCOS or GTOS as well as GOOS. Thus, it is imperative to retain close connections between the global observing systems when planning new capacity building initiatives.

ANNEX A: Definition of IOC Capacity Building

Recognizing that many coastal states lack the capabilities in marine science required for them to fully participate in, contribute to, or benefit from the four main themes of the IOC:

1. To develop, promote and facilitate international oceanographic research programmes to improve our understanding of critical global and regional ocean processes and their relationship to the sustainable development and the stewardship of ocean resources;

2. To ensure effective planning, establishment and coordination of an operational global ocean observing system to provide the information needed for oceanic and atmospheric forecasting, for ocean and coastal zone management by coastal nations and for global environmental change research;

3. To provide the international leadership for education and training programmes and technical assistance essential to systematic observations of the global ocean and its coastal zone and related research;

4. To ensure that ocean data and information obtained through research, observation, and monitoring are efficiently handled and made widely available;

the IOC has developed a cross-cutting theme focused on the development of national capabilities in marine sciences and services. The IOC Programme for this building of capacity involves a wide range of activities, depending on the starting capacity (or level of ability) of the country concerned. The activities fall under the general headings of Training, Education, and Mutual Assistance, and are managed through the TEMA Programme, which includes technology transfer. A first step in building capacity is raising awareness of the activities involved, the benefits that may accrue from participation, and the likely costs.

ANNEX B: Examples of Capacity Building Actions Required

Given the need for initial baseline networks of stations and sections as part of an integrated global observing system, priority should be given to creating, strengthening, and/or rehabilitating reference stations or sections in the waters around nations requiring assistance.

Equally high priority should be given to establishing or improving data receiving, distribution, and processing centers in nations requiring assistance ensure full data acquisition and use. (In the context of GOOS, there are a number of data centers managed by the IOC's Committee on International Oceanographic Data and Information exchange (IODE). Many need upgrading to incorporate the full range of multi-disciplinary data. Special centers should be created in a few places to handle advanced processing and assimilation of oceanographic data into regional ocean and climate models. Such is proposed by the Southeast Asian Centre for Atmospheric and Marine Prediction (SECAMP) project serving the needs of southeast Asia from Singapore.).

It also is important to ensure that nations are capable of benefiting from and involved in environmental monitoring. This requires that:

- such countries have access to data and products along with the capacity to produce and utilize high-level products and data sets consisting of both satellite and *in situ* data;
- the introduction of new facilities be matched by training and support in their use, particularly focused on the generation of advisory services and products;
- scientists from nations needing assistance be able to participate fully in the work of major national and international centers engaged in advanced data processing, as for seasonal and climate scale predictions; and
- full use be made of existing capacity building programmes, such as IOC's Training Education and Mutual Assistance (TEMA) programme in the GOOS context, and START (the Global Change System for Analysis Research and Training) in the IGBP context.

ANNEX XIII

LIST OF ACRONYMS

C-GOOS	Coastal Panel of GOOS
CAOS	Coordinated Adriatic Observing System
CARICOMP	Caribbean Coastal Marine Productivity Programme
CDOM	Coloured Dissolved Organic Matter
CHL	Chlorophyll
CMS	Centre of Marine Studies of the Federal University of Parana
COMAR	Coastal Marine
CoMSBLACK	Cooperative Marine Science Programme for the Black Sea
CPR	Continuous Plankton Recorder
CSD	Commission on Sustainable Development
CSI	Coastal Regions and Small Island States
CZCS	Coastal Zone Colour Scanner System
DFID	Department for International Development
EASY	Environmental analysis system
EuroGOOS	European GOOS
FANSA	Goupo de Trabajo sobre Floraciones Algales Nocivas en Sudamérica
GCOS	Global Climate Observing System
GCRMN	Global Coral Reef Monitoring Network
GEOHAB	Global Ecology of Harmful Algal Blooms
GIPME	Global Investigation of Pollution in the Marine Environment
GLOBEC	Global Ocean Ecosystem Dynamics
GLOSS	Global Sea-Level Observing System
GODAE	Global Ocean Data Assimilation Experiment
GOSSP	Global Observing Systems Space Panel
GPO	GOOS Project Office
GSC	GOOS Steering Committee
GTOS	Global Terrestrial Observing System
HAB	Harmful Algal Bloom
HEED	Health, Ecological and Economic Dimensions of Global Change Programme
HELCOM	Helsinki Commission
HOTO	Health of the Oceans
IAEA	International Atomic Energy Agency
ICAM	Integrated Coastal Area Management
ICES	International Council for the Exploitation of the Sea
ICRI	International Coral Reef Initiative
ICSU	International Council for Science
IGBP	International Geosphere - Biosphere Programme
IGU	International Geographical Union
IHP	International Hydrological Programme
IMO	International Maritime Organization
IOC	Intergovernmental Oceanographic Commission
IODE	International Ocean Data and Information Exchange programme
ISRS	International Society for Reef Studies
IUCN	International Union for the Conservation of Nature (and Natural Resources)
J-DIMP	Joint Data and Information Management Panel
LABNET	Network of US Coastal Laboratories
LMR	Living Marine Resources
LOICZ	Land-Ocean Interactions in the Coastal Zone
MAP	Mediterranean Action Plan
MAST	Marine Science and Technology programme
MedGOOS	Mediterranean GOOS
NGOs	Non-governmental Organizations
NOAA	National Oceanic and Atmospheric Administration
NODCs	National Oceanographic Data Centres

NOWPAP	Northwest Pacific Action Plan
OOPC	Ocean Observing panel for Climate
OOSDP	Ocean Observing System Development Panel
OSPARCOM	Oslo-Paris Commission
PACSICOM	Pan African Conference on Sustainable Integrated Coastal Management
PICES	Pacific ICES
PSMSL	Permanent Service for Mean Sea-Level
PSP	Paralytic Shellfish Poisoning
RAMP	Rapid Assessment of Marine Pollution
ROSE	Radar Ocean Sensing
SAR	Synthetic Aperture Radar
SEAGNET	Seagrass Network
SIDA-SAREC	Swedish Development Agency
SPREP	South Pacific Regional Environment Programme
SS	Suspended Solids
TAO	Tropical Atmosphere Ocean (buoy array)
TEMA	Training, Education and Mutual Awareness
TSM	Total Suspended Matter
TWAS	Third World Academy of Sciences
UFDP	Federal University of Parana
UNEP	United Nations Environment Programme
WESTPAC	IOC's regional group for the western Pacific
WIOMAP	Western Indian Ocean Marine Applications Project
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WWW	World Weather Watch