6.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

6.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

6.1 Intergovernmental Oceanographic Commission

Robert Duce and Ed Urban attended the IOC Executive Council meeting in June 2004 to represent SCOR. Several items were relevant to SCOR, and Duce and Urban made official interventions related to these issues (see below). In addition, the first day of the meeting featured scientific presentations that included mentions of SCOR contributions to joint activities with IOC, such as GLOBEC, WG 112 on Submarine Groundwater Discharges, and WOCE.

IOC Agenda Item 4.1.5—Joint SCAR-SCAR-IOC Co-ordination of Southern Ocean Studies

Thank you, Mr. Chairman, for the opportunity to provide comments about this item.

SCOR, SCAR, and IOC have cooperated several times in past decades on science activities in the Southern Ocean, as listed in Annex 5. SCOR has co-sponsored, with IGBP and/or IOC, two international research projects in the past decade with Southern Ocean components: (1) the Joint Global Ocean Flux Study (JGOFS) and (2) the Global Ocean Ecosystem Dynamics (GLOBEC) project. In preparation for at least three new SCOR-sponsored research projects with Southern Ocean components, SCOR and SCAR have agreed to initiate a mechanism to help coordinate research in the Southern Ocean, to stimulate integration of physical, chemical, and biological measurements and research.

SCOR believes that the proposed mechanism is a relatively inexpensive approach that could result in benefits for Southern Ocean research and contribute to the International Polar Year activities of each co-sponsor.

SCOR convened an ad hoc discussion of this idea in 2001, as noted in Annex 5, but we were not able to arrange funding through SCOR for the entire cost of the activity. However, SCAR suggested an alternative approach of each organization supporting their own representatives. A SCOR meeting in September can provide an opportunity among research projects, and representatives of SCOR, SCAR, IOC, GOOS, and others to discuss potential cooperation in Southern Ocean measurements and research.

SCOR welcomes the opportunity to work with SCAR and IOC on this initiative. As demonstrated by several of the presentations yesterday, SCOR and IOC, working together, in this case also with SCAR, can combine our unique capabilities to address common issues. Thank you, Mr. Chairman.

IOC Agenda Item 4.2.1—The New GESAMP

Thank you Mr. Chairman:

SCOR thanks the speaker for his excellent review of the new GESAMP. SCOR was closely involved in the external review of GESAMP, identifying two of the four members of the review team. We commend GESAMP and the United Nations agencies and programs, including IOC, that support GESAMP for their development of a comprehensive strategic plan for the new GESAMP that incorporates the recommendations of the review committee. In particular, SCOR applauds the continuing recognition of the importance of the independence of the scientists who serve as members of GESAMP. We also strongly support the increased involvement of governments in the selection of topics and issues that GESAMP will address, as well as their nominations of scientists from their countries to the GESAMP panel of experts. We believe that the new GESAMP will provide significantly enhanced scientific advice in the area of marine environmental protection.

IOC Agenda Item 4.2.2—SCOR/IOC Symposium on Quantitative Indicators for Fisheries Management

Intervention on WG 119 (this is a paraphrase)

SCOR wishes to thank the co-chairs Cury and Christiansen for their good work on this activity. SCOR is pleased to have worked on many aspects of fisheries oceanography activities with IOC, such as GLOBEC and previous working groups. The recent WG 119 conference was very successful and made significant progress on this topic. SCOR offers its assistance to IOC on activities to follow up on the results of the conference.

6.1.1 IOC/SCOR Coastal Ocean Advanced Scientific and Technical Studies (COASTS)

SCOR provided some support for the meeting related to the COASTS project and may purchase copies of the books from the project.

6.1.2 Global Ocean Observing System (GOOS)

The Coastal Module of the Global Ocean Observing System

Tom Malone and Tony Knap
Co-Chairs, Coastal Ocean Observations Panel (COOP) of the IOC

1. Changes in Coastal Ecosystems

The combined effects of climate change and human alterations of the environment are especially pronounced in the coastal zone where inputs of energy and matter from land, sea and air converge. Coastal ecosystems are experiencing unprecedented changes as indicated by the frequency or magnitude of a wide diversity of phenomena (Table 1) that affect the safety and efficiency of marine operations, the susceptibility of coastal populations to natural hazards, public health risks, the health of coastal marine and estuarine ecosystems, and the sustainability of living marine resources. Increases in the occurrence of many of these phenomena indicate profound changes in the capacity of coastal ecosystems to support goods and services. They are making the coastal zone more susceptible to natural hazards, more costly to live in, and of less value to national economies. In the absence of a system for improved detection and prediction of the phenomena of interest and their environmental and socio-economic consequences, conflicts between marine commerce, recreation, development, environmental protection, and the management of living resources will become increasingly contentious and politically charged. The social and economic costs of uninformed decisions will increase accordingly.

Anthropogenic and natural drivers of change and their expressions in terms of the phenomena of interest are not independent of each other. Coastal ecosystems are subject to multiple drivers of change and any given driver may have multiple effects that are exacerbated by other drivers of change and their effects. Major anthropogenic drivers of change include (1) extractions of living marine resources; (2) land-use practices that alter inputs of water, sediments, nutrients, human pathogens, and chemical contaminants from coastal drainage basins; (3) physical alteration of habitats; (4) the globalization of marine commerce; and (5) the release of greenhouse gases. Changes in the state of marine systems occur through natural processes as well. Thus, many of the changes occurring in coastal ecosystems are related to extreme weather and to large-scale, natural processes such as the El Niño-Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), and the North Atlantic Oscillation (NAO).

2. Managing Human Use in the Context of Natural Variability

Changes in the frequency of or secular trends in the magnitude of the phenomena of interest reflect both the dynamics of coastal ecosystems and the nature of the external forces that impinge on them directly or indirectly via the propagation of variability among scales (global ⇔ regional ⇔ local). However, current efforts to manage human uses and mitigate their impacts typically

focus on specific human activities, specific habitats and places or individual species without due consideration of the propagation of variability and change across multiple scales in time, space and ecological complexity. It is becoming increasingly clear that managing human uses and mitigating their effects with the goals of sustaining and restoring healthy ecosystems and the goods and services they support can best be achieved through ecosystem-based strategies that consider ecosystems and their state changes in a regional context where a *region* is defined as the next larger scale that must be observed to understand and predict the local scale of interest.

Table 1. Natural and anthropogenic drivers of change (forcings) and their expression in terms of phenomena of interest in coastal marine and estuarine ecosystems that affect the safety and efficiency of marine operations, the susceptibility of human populations to natural hazards and global climate change, public health risks and ecosystem health, and the sustainability of living marine resources. Natural drivers of change occur in the absence of human intervention but may be altered or enhanced by human activities. With the exception of introductions of human pathogens and chemical contamination, anthropogenic drivers fall into the latter category.

	FORCINGS OF INTEREST
"Natural"	• Global warming, sea level rise • Natural hazards (extreme weather, seismic events) • Currents, waves, tides & storm surges • River & groundwater discharges, sediment inputs
Anthropogenic	• Alteration of hydrological & nutrient cycles • Inputs of chemical contaminants & human pathogens • Harvesting natural resources (living & nonliving) • Physical alterations of the environment • Introductions of non-native species
	PHENOMENA OF INTEREST
Climate & weather	• Variations in sea surface temperature; surface fluxes of momentum, heat & fresh water; sources & sinks of carbon; sea ice
Marine operations	• Variations in water level, bathymetry, surface winds, currents & waves; sea ice; susceptibility to natural hazards
Natural hazards	• Storm surge & coastal flooding; coastal erosion & loss of buffer habitats; sea level; public safety & property loss
Public health	• Risk of exposure to human pathogens, chemical contaminants, and biotoxins (contact with water, aerosols,

	seafood consumption)
Healthy Ecosystems	• Habitat modification, loss of biodiversity, cultural eutrophication, harmful algal events, invasive species, diseases in & mass mortalities of marine organisms
Living marine resources	• Fluctuations in spawning stock size, recruitment & natural mortality; changes in spatial extent & condition of essential habitat; food availability & hydrographic conditions

The goal of formulating ecosystem-based approaches to managing human activities and mitigating their effects, as well as those of extreme weather and global warming, begs the question of how to define ecosystems and specify boundary conditions in marine environments that are not constrained by geographically fixed boundaries. Large marine ecosystems (LMEs) provide a good first approximation. LMEs encompass large areas of the coastal ocean (> 200,000 km^2) and are characterized by distinct hydrographic regimes, submarine topography, productivity and trophic structures. Although porous, the boundaries of LMEs are based on the concept that critical processes controlling the structure and function of marine ecosystems are best addressed in a regional context. They are natural ecological units for ecosystem assessments and ecosystem-based, adaptive management.

In addition to establishing initial boundary conditions, the development of an ecosystem-based approach involves a shift from highly focused, short-term sectoral approaches as now practiced to a more holistic approach that spans multiple scales in time, space and ecological complexity. Implementing ecosystem-based approaches depends on the ability to engage in adaptive management in which decisions are influenced by knowledge of the current state of marine ecosystems and natural environmental variability. This requires the capacity to routinely and rapidly assess environmental conditions, detect changes, and provide timely predictions of likely future states. *We do not have this capacity today*.

3. Linking Science and Management

Effective environmental management and sustainable use of natural resources depends (1) on efficient coupling between advances in the environmental sciences and their application for the public good and (2) on our understanding of the interdependency of ecological and socio-economic systems. Today, there are unacceptable gaps between these processes on both counts. Although the challenges are many, successful establishment of the Global Ocean Observing System will fill the current void between science and management through the routine and repeated provision of scientifically credible, quantitative assessments of the status of coastal ecosystems on local, regional and global scales.

The observing system for the World Weather Watch is a case in point (Figure 1). The WWW is an operational observing system that consists of three closely linked subsystems: (1) a global monitoring network of sensors and platforms (surface and radiosonde networks and aircraft- and satellite-based sensors to monitor wind velocity, atmospheric pressure, and air temperature and moisture content from the earth's surface to the outer limits of the troposphere) with a global telecommunications subsystem (GTS) for data telemetry; (2) a global network of data centers that collect, process, archive and disseminate data and information in near real-time; and (3) numerical weather prediction centers. In addition to providing and managing the data required for numerical weather predictions, the data served by the observing system benefits the environmental sciences which enable improved forecasting skill through advances in sensor technologies and understanding of the causes of atmospheric variability on global to local scales. This synergistic relationship not only sustains the integrity of meteorological research (hypothesis-driven, research projects that are finite in duration), it strengthens it.

The WWW observing system is a useful model of an operational, "end-to-end" system. However, unlike the WWW which has a singular purpose, the GOOS is a multi-purpose system, the development of which depends on and benefits a broad spectrum of scientific disciplines (Figure 1). Development of an observing system that effectively links scientific advances in many disciplines to the information needs of multiple user groups will require a sustained effort by many groups that do not have history of collaboration to achieve common ends. Thus, many of the challenges are cultural, not technical.

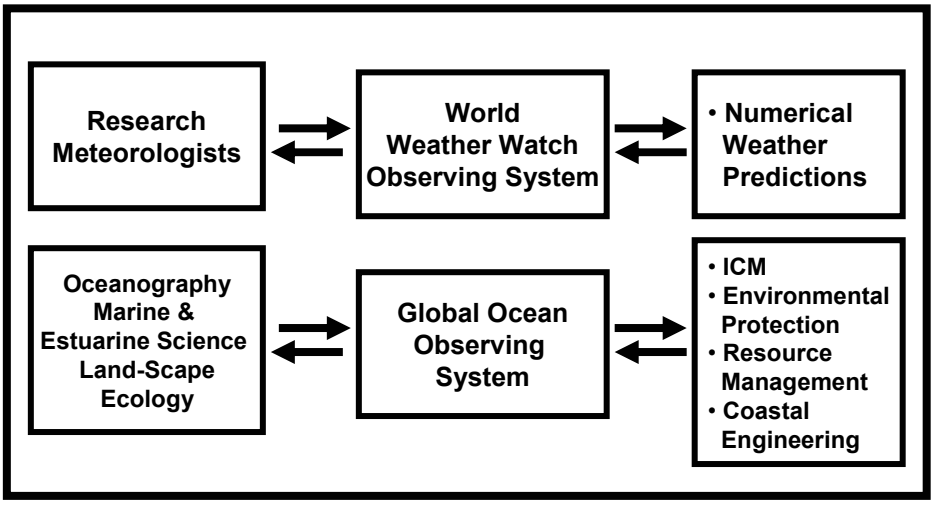

Figure 1. The observing system for the World Weather Watch is operational (routine, continuous provision of meteorological data and data-products of known quality) with guaranteed data streams and products (nowcasts forecasts of the weather and weather patterns on local to global scales). The operations system benefits from meteorological research, but numerical weather prediction are not dependent on the meteorological research community directly. The operational system also contributes to advances in the science of meteorology, but

its primary purpose (and motivation for government funding) is to predict the weather for the public good, e.g., to improve social and economic conditions. A similar but more complex system, the Global Ocean Observing System, is needed for coastal and ocean environments (ICM – Integrated Coastal Management).

4. The Coastal Module of the Global Ocean Observing System

Purpose and Scope

The purpose of the GOOS is to establish a sustained and integrated ocean observing system that makes more effective use of existing resources, new knowledge, and advances in technology to continuously provide data and information in forms and at rates required to more effectively achieve six related societal goals:

1) improve the safety and efficiency of marine operations;
2) control and mitigate the effects of natural hazards;
3) improve the capacity to detect and predict the effects of global climate change on coastal ecosystems;
4) reduce public health risks;
5) protect and restore healthy ecosystems; and
6) restore and sustain living marine resources.

Achieving these goals depends on developing the capacity to assess the status of marine systems and to detect and predict changes in them rapidly and routinely. Although each goal has unique requirements for data and information, they have many data needs in common. Likewise, the requirements for data communications management are similar across all six goals. Thus, an integrated approach to the development of a multi-use, multi-disciplinary observing system is feasible, sensible and cost-effective.

GOOS is a movement to integrate, enhance and supplement existing research and monitoring activities for rapid data acquisition, dissemination, and analysis in response to the needs of governments, industries, science, education, and the public for information on marine and estuarine environments. The System is envisioned as a sustained and integrated global network that routinely and systematically acquires and disseminates data and data products on past, present and future states of the marine environment, ecosystems and the goods and services they provide. The observing system is being organized in two interdependent and convergent modules: (1) the global ocean module being developed by the Ocean Observations Panel for Climate (OOPC) and (2) the coastal module being developed by the Coastal Ocean Observations Panel (COOP). The former is primarily concerned with changes in and the effects of the ocean-climate system on physical processes of the upper ocean and on the global carbon budget. The latter is primarily concerned with the effects of climate and human activities on coastal ecosystems and socio-economic systems of coastal nations including marine operations.

A Global System for the Coastal Ocean

The design of coastal GOOS must take into account the changing mix of ecosystem types that constitute the coastal environment in different regions of the world and the time-space scales that characterize the phenomena of interest within them. In this context, design and implementation must also consider (1) the need to address a broad diversity of phenomena encompassed by the 6 goals; (2) although the six goals of GOOS have unique requirements for data, data management, and analysis, they have many requirements in common; (3) the phenomena of interest tend to be local expressions of larger scale forcings; (4) ecosystem theory posits that the phenomena of interest are related through a hierarchy of interactions; and (5) the kinds of ecosystems and resources that constitute the coastal ocean and priorities for detection and prediction differ among regions.

The coastal module consists of a Global Coastal Network (GCN) and Regional Coastal Ocean Observing Systems (RCOOSs) that link global, regional and local scales of variability through a hierarchy of observations, data management and models (http://ioc.unesco.org/goos/). To the extent that the six goals of coastal GOOS have data requirements in common, a global network of observations provides economies of scale that minimizes redundancy and allow regional observing system to be more cost-effective. In this context, there is a relatively small set of variables that, if measured with sufficient resolution for extended periods over sufficiently large areas, will serve many needs from forecasting changes in sea state and the effects of tropical storms and harmful algal events on short time scales to predicting the environmental consequences of human activities and climate change on longer time scales. These are the "common" variables that are required by most regional systems and are to be measured and processed as part of the global coastal network (Table 2). Depending on national and regional priorities, GOOS Regional Alliances (GRAs) may increase the resolution at which common variables are measured, supplement common variables with additional variables, and provide data and information products that are tailored to the requirements of stakeholders in the respective regions. Thus, GRAs both contribute to and benefit from the global network.

Table 2. Common variables recommended by the Coastal Ocean Observations Panel to be measured as part of the global coastal system. This initial list of common variables is a first step in the process of determining what variables to measure as part of the global coastal observing system. The list will change as the Global Federation of Regional Observing Systems comes into being. The procedure for selecting the common variables is described in more detail in the "The Integrated, Strategic Design Plan for the Coastal Ocean Observations Module", the software for which may be downloaded from www.phys.ocean.dal.ca/~lukeman/COOP/.

Physical	Sea level, Bathymetry & Shoreline position Temperature & Salinity Currents & Surface Waves Sediment grain size Attenuation of solar radiation
Chemical	Sediment organic content Dissolved inorganic nitrogen, phosphorus, & silicon Dissolved oxygen
Biological	Benthic biomass Phytoplankton biomass Fecal indicators

It must be emphasized that the global network will not, by itself, provide all of the data and information required to detect and predict changes in or the occurrence of many of the phenomena of interest. Additional variables must be measured to quantify external forcings of coastal ecosystems. These include large scale ocean processes and inputs from atmospheric and land-based sources to be measured as part of the overall Integrated Global Observing Strategy. In addition, there are categories of variables that are important globally, but the actual variables measured change from region to region. These include species-specific stock assessments for fisheries management; coral reefs, sea grass beds, tidal marshes and mangrove forests; species of harmful algae, marine mammals, turtles and birds; and chemical contaminants. Decisions on what variables to measure, the time and space scales of measurements, and the mix of observing techniques to be used are best made by stakeholders in the regions affected. Thus, the establishment of regional observing systems will be critical to detecting and predicting most of the phenomena of interest in the public health, ecosystem health and living marine resources categories.

In addition to economies of scale and improved cost-effectiveness, the global network will establish, maintain, and improve the observational, data management and modelling infrastructure that benefits national and regional observing systems in several important ways:

- provide a network of reference and sentinel stations and sites to establish long-term time-series observations, provide advanced warnings of events and trends, and enable adaptive monitoring for improved detection and prediction;
- establish internationally accepted standards and protocols for measurements, data dissemination, management, and models;
- optimize data and information exchange;
- link the large-scale network of observations for the ocean-climate module to the local scales of interest in coastal ecosystems and provide information on open boundary conditions and atmospheric forcings;
- provide the means for comparative ecosystem analysis required to understand and predict variability on local scales of interest; and
- facilitate capacity building.

Elements of an End-To-End Observing System

Both detection and prediction depend on the development of an integrated and sustained observing system that effectively links measurements to data management and analysis for more timely access to data and delivery of environmental information. The system must be integrated to effectively link the interdependent processes of monitoring and modeling and to provide multi-disciplinary (physical, geological, chemical and biological) data and information to many user groups. Linking user needs to measurements to form an end-to-end, user-driven system requires a managed, two-way flow of data and information among three essential subsystems (Fig. 2):

- The observing subsystem (networks of platforms, sensors, sampling devices, and measurement techniques) to measure the required variables and transmit data on the required time and space scales;
- The data management subsystem (protocols and standards for quality assurance and control, data dissemination and exchange, archival, user access) and communications (data dissemination and access); and
- The data assimilation, analysis and modeling subsystem.

One System, Six Goals

As discussed above, GOOS is intended to provide the data and information required to achieve six broad goals. The capacity to rapidly detect and predict extreme weather and the physical conditions of the upper ocean is far more advanced than the capacity to rapidly detect and predict changes in public health risks, ecosystem health, and the sustainability of living marine resources Thus, the evolution of the coastal module of GOOS depends on advances in both technologies and knowledge.

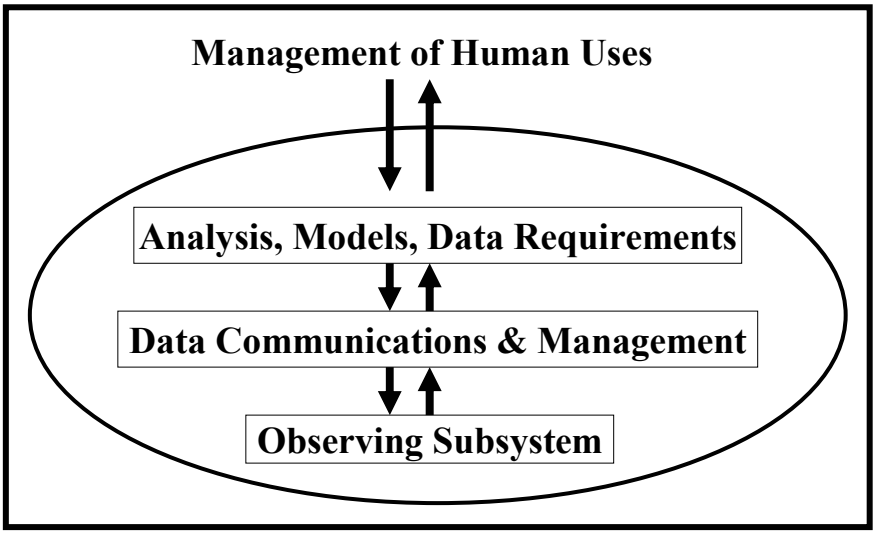

Figure 2. The observing system consists of three subsystems (inside the oval), the development of which is driven by user requirements, technical capabilities, and the sustainable investments in infrastructure (capitalization) and operations (including the required technical expertise). Depending on capabilities and needs, user groups may access data from any one or all of the subsystems directly.

The evolution of the coastal module will be guided by many considerations, including the following:

1) The data requirements for improved coastal marine services are, for the most part, common to all of the goals addressed by the coastal module. Safe and efficient coastal marine operations and the mitigation of natural hazards require accurate nowcasts and timely forecasts of storms and coastal flooding; of coastal current-, wave-, and ice-fields; and of water level, temperature and visibility. The set of variables that must be measured and assimilated in near real time include barometric pressure, surface wind vectors, air and water temperature, sea level, stream flows, surface currents and waves, and ice extent.

2) In addition to these variables, minimizing public health risks and protecting and restoring coastal ecosystems require timely data on environmental variables needed to detect and predict changes habitats and in biological, chemical and geological properties and processes, e.g., distributions of habitat types, concentrations of nutrients, suspended sediments, contaminants, biotoxins and pathogens; attenuation of solar radiation; biomass, abundance and species composition of plants and animals; and habitat type and extent. Mitigating the effects of natural hazards and reducing public health risks also

requires a predictive understanding of the effects of habitat loss and modification (coral reefs, barrier islands, tidal wetlands, sea grass beds, etc.) on the susceptibility of coastal ecosystems and human populations to them.

3) In addition to data on the state of marine ecosystems (e.g., hydrography, currents, distribution and condition of critical habitats), the demands of sustaining living marine resources and managing harvests (of wild and farmed stocks) in an ecosystem context require timely information on population (stock) abundance, distribution, age- (size) structure, fecundity, recruitment rates, migratory patterns, and mortality rates (including catch statistics).

Thus, the system is being designed to evolve and incorporate biological and chemical variables as new technologies, knowledge and operational models are developed.

5. Research to Operational Oceanography

Closing the gap between advances in the environmental sciences and applications of new technologies and knowledge to achieve the six societal goals given above depends on the establishment of mechanisms for efficiently incorporate new knowledge and technologies from research to an operational mode. An iterative process is needed by which advances in technology and knowledge are identified, selected, incorporated, and evaluated over time. The selection process by which candidate technologies, data management techniques and models become incorporated into an operational system can be conceptualized as in four stages as follows:

Research Projects: Observational (platforms, sensors, measurement protocols, data telemetry), data management and communications, and analytical (e.g., models and algorithms) techniques are developed by research groups. Research programs such as LOICZ, GLOBEC and GEOHAB are critical to the development of a fully integrated and operational coastal module.

Pilot Projects: Acceptance of techniques by research and operational communities is gained through repeated testing and pilot projects designed to demonstrate their utility and sustainability in a routine, operational mode. Techniques that show promise as potential elements of the operational system or sustained observations for research are tested repeatedly over a range of conditions. This exposes weaknesses, provides opportunities to address those weaknesses, and permits a better understanding of how they may be applied. Research groups, with involvement of operational groups, are primarily responsible for this stage.

Pre-Operational Projects: Research and operational communities collaborate to ensure that incorporation of new techniques from pilot projects into the operational system are likely to lead to a value-added product (is more cost-effective, improves or expands existing capabilities) and will not compromise the integrity and continuity of existing data streams and product delivery of the operational system. Operational groups, with the involvement of researchers, are primarily

responsible for this stage.

The Operational System: Routine and sustained provision of data and data products in forms and at rates specified by user groups are performed by operational groups with researchers functioning as advisors and users. This stage is improved through the incorporation of elements that are successful in a pre-operational mode. The appropriate government agency, ministry or GOOS Regional Alliance is responsible for the coordinated incorporation of such elements into the operational system, i.e., successful pre-operational projects, or elements thereof, are transferred to an operational agency, office, center or GRA for incorporation into the operational system.

Although presented as a linear sequence, in practice all four stages will be in play simultaneously with feedback among all stages. Research and development projects (stages 1-3) may focus on elements of the system (a particular sensing technology, development of sampling protocols, model development, data management protocols, etc.) or on the development of an integrated system (e.g., end-to-end, regional observing systems). Successful pilot projects, or elements thereof, may be incorporated into long-term time series observations for scientific purposes, may become pre-operational, or both.

From sensing capabilities to models, operational capabilities are most developed for safe and efficient marine operations, forecasting extreme weather and its impacts on coastal populations, and predicting long-term climate change. Thus, the initial GOOS is primarily concerned with improving forecasts of marine weather, natural hazards, and surface currents and waves and with predicting global climate change with greater skill. Developing those aspects of the observing system concerned with ecosystem health and living marine resources will require synergy between research and the evolution of operational oceanography with an emphasis on *in situ* and remote sensing of biological and chemical properties, the formulation of climatologies for chemical and biological properties, and the development of data assimilation techniques and operational models that link physical and ecological processes for routine nowcasts and forecasts of phenomena of interest relevant to reducing public health risks and sustaining and restoring healthy ecosystems and the natural resources they support in an ecosystem context.

ACKNOWLEDGEMENTS

This contribution is based on and has been enriched by discussions with Keith Thompson, John Cullen, Bob Bowen, Julie Hall, Worth Nowlin, Jr., and the entire Coastal Ocean Observing Panel including Dagoberto Arcos, Bodo von Bodungen, Alfonso Botello, Lauro Calliari, Mike Depledge, Eric Dewailly, Juliusz Gajewski, Johannes Guddal, Hiroshi Kawamura, Coleen Moloney, Nadia Pinardi, Hillel Shuval, Vladimir Smirnov, and Mohideen Wafar. The Panel's work has been supported by the Intergovernmental Oceanographic Commission and its member States.

6.2 Other Intergovernmental Organizations

6.2.1 Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)

GESAMP
(Group of Experts on the Scientific Aspects of Marine Environmental Protection)

GESAMP has developed a Strategic Vision of its future functions and operations, largely on the basis on an external review in which SCOR participated. To implement the Strategic Vision, GESAMP's Sponsoring Organizations (UN, UNEP, FAO, UNESCO-IOC, WHO, WMO, IMO, and IAEA) are in the process of considering a draft Memorandum of Understanding that outlines the functions, institutional structure, organization, and financial arrangements for the "New GESAMP". UNIDO has expressed interest in becoming a new sponsor of GESAMP and is also considering the MOU. Upon approval by the agencies this MOU will replace the current MOU governing GESAMP's operations.

In the meantime, steps are underway to begin implementing some features of the MOU, notably the development of a pool of experts from which members of GESAMP, GESAMP working groups, and peer reviewers would be drawn, and the establishment of a GESAMP Office. The Office would provide more efficient management of GESAMP activities and a focal point for interactions with other bodies. Some new funds have been allocated for the Office and IAEA has offered space at its marine laboratory in Monaco.

GESAMP has made several contributions to the possible development of a regular UN process for global marine assessment (GMA), including participation in a number of workshops and expert meetings and a submission on possible modalities for a GMA to the UN General Assembly through the UN Division for Ocean Affairs and Law of the Sea. GESAMP stands ready to contribute to a GMA as appropriate.

A GESAMP Working Group is in the process of finalizing a report estimating inputs of oil into the global marine environment from sea-based activities. Three other Working Groups are currently active:

1. The Evaluation of the Hazards of Harmful Substances Carried by Ships;
2. Environmental Risk Assessment and Communication in Coastal Aquaculture; and
3. Environmental exposure models for application in seafood risk analysis.

From Michael E. Huber, Chair of GESAMP

6.2.2 North Pacific Marine Science Organization (PICES)

Existing and Potential Areas of Cooperation between SCOR and PICES
Report at the 27th SCOR General Meeting
Venice, Italy
September 27-30, 2004

The North Pacific Marine Science Organization (PICES) is an intergovernmental scientific organization and its current membership includes Canada, Japan, People's Republic of China, Republic of Korea, the Russian Federation, and the United States of America. The Organization was established in 1992: (i) to promote and co-ordinate marine scientific research in the northern North Pacific and adjacent marginal seas; (ii) to advance scientific knowledge about the ocean environment, global weather and climate change, living resources and their ecosystems, and the impact of human activities on them; and (iii) to promote the collection and rapid exchange of scientific information on these issues.

PICES and SCOR have many coinciding interests, and PICES scientists have been important contributors to certain SCOR activities. Continuing and extending cooperation with SCOR is important for PICES to advance the scientific agenda of the Organization. Conversely, PICES could play the important role in bringing a regional perspective to global activities of SCOR. In September 2003, Dr. Vladimir Radchenko (PICES Science Board Vice-Chairman) attended the 36th SCOR Executive Committee meeting, and in October 2003, Dr. Akira Taniguchi (SCOR Vice-President) participated in the PICES Twelfth Annual Meeting, to review and discuss existing and future cooperation between the two organizations. Dr. Taniguchi specifically mentioned PICES' contribution in GLOBEC and JGOFS projects, in organizing the Symposium on "Quantitative ecosystem indicators for fisheries management", and in improving the quality of oceanic CO_2 measurements and resolving CO_2 data synthesis issues. He also advised that SCOR hoped that PICES will play an important role in the implementation of SOLAS, IMBER and GEOHAB.

On-going and potential collaborations between PICES and scientific projects and programs, working groups and activities established/sponsored by SCOR are listed below.

PROJECTS/PROGRAMS SPONSORED BY SCOR

Global Ocean Ecosystem Dynamics project (GLOBEC)

- The PICES Climate Change and Carrying Capacity (CCCC) Program provides a mechanism for integrating national GLOBEC research programs in the North Pacific and is a regional component of the international GLOBEC effort.
- PICES co-sponsored the GLOBEC/SPACC Workshop to compare long-term data on small pelagics from the Kuroshio/Oyashio system with those of other ecosystems in the Pacific and

Atlantic Oceans to better understand mechanisms which govern regime shifts (December 8-10, 2003, Tokyo, Japan).

- A special issue of the *ICES Journal of Marine Science* (Guest editors: Roger Harris, Tsutomu Ikeda, William Peterson and Luis Valdez) was published in June 2004 based on selected papers presented at the PICES/GLOBEC/ICES 3rd Zooplankton Production Symposium on "The role of zooplankton in global ecosystem dynamics: Comparative studies from the World Oceans" that was held May 20-23, 2003, in Gijón, Spain.
- The GLOBEC Focus 3 Working Group on *Linking biophysical and upper trophic level models* and the PICES MODEL Task Team were the key players in the SCOR/IOC Study Group on *Extending ecosystem models to the basin scale*. Two workshops convened by this Study Group in May and October 2003 (Cambridge, UK) resulted in the publication of a multi-authored background paper "Challenges in modeling ocean basin ecosystems" in *Science* in 2004.
- Several scientific sessions directly related to GLOBEC activities will be convened at PICES XIII to be held October 14-24, 2004, in Honolulu, U.S.A.. (*e.g.*, **S2:** *Mechanisms that regulate North Pacific ecosystems: Bottom-up, top-down, or something else? and* **S9:** *The impacts of large-scale climate change on North Pacific marine ecosystems*)
- The GLOBEC Focus 1 Working Group on *Retrospective analysis* will meet in conjunction with PICES XII and contribute joint and individual papers to the CCCC Topic Session on "The impacts of large-scale climate change on North Pacific marine ecosystems". This will provide an opportunity for PICES CCCC scientists to interact more closely with GLOBEC synthesis efforts.
- PICES will act as a co-sponsor and a local organizer for the GLOBEC Symposium on "Climate variability and sub-arctic marine ecosystems" to be held May 16-20, 2005, in Victoria, Canada. The symposium's scientific objective is to present current knowledge of the effects of seasonal to multi-decadal climate variability on the structure and function of sub-arctic marine ecosystems. The two accompanied workshops will discuss the Implementation Plans of BEST (U.S. national program on ***B**ering **E**cosystem **St**udy*) and of ESSAS (new GLOBEC regional program on ***E**cosystem **S**tudies of **S**ub-**A**rctic **S**eas*).
- GLOBEC will co-sponsor the PICES/CCCC Symposium on "Climate variability and ecosystem impacts on the North Pacific: A basin-scale synthesis" to be held April 19-21, 2006, in Honolulu, U.S.A. The primary scientific objective of this symposium is to present a synthesis of the effects of seasonal to multi-decadal variability on the structure and function of the North Pacific that goes beyond the analysis and understanding developed from studies of a single trophic level, process or region—a True Synthesis.
- PICES and GLOBEC agreed to work together to organize the 4th International Zooplankton Production Symposium to be held in spring 2007, in Hiroshima, Japan (Local sponsors/organizers are the Plankton Society of Japan and the Japanese Society of Fisheries Oceanography).

Joint Global Ocean Flux Study (JGOFS)

- Selected papers from the PICES/JGOFS Topic Session on "Plankton size classes, functional groups and ecosystem dynamics: Causes and consequences" at PICES X were published as a

special issue of *Progress in Oceanography* (Guest editors: A. Peña and A. Bychkov) published in October 2003 (Vol. 57, Nos. 3-4). The issue includes 11 papers by authors from Canada, Chile, Japan, Korea and U.S.A.

- A collection of invited papers on *JGOFS North Pacific Synthesis* was published as a special issue of *Journal of Oceanography* (Guest Editors: T. Saino, A. Bychkov, C.T.A. Chen and P. Harrison) in February 2004 (Vol. 60, Nos. 1-2). The issue includes 13 papers by authors from Canada, Germany, Japan, Russia and U.S.A. A DVD with data sets obtained during the North Pacific Process Studies will be released by the Japan Oceanographic Data Center (JODC) in fall 2004.

Surface Ocean-Lower Atmosphere Study (SOLAS)

- Iron enhancement experiments are an important part in the agenda of both SOLAS and PICES. In summer of 2001, an iron enrichment experiment (**S**ubarctic Pacific Iron **E**xperiment for **E**cosystem **D**ynamics **S**tudy – SEEDS-I) was performed in the western subarctic Pacific, and in summer of 2002, another iron enrichment experiment (**S**ubarctic **E**cosystem **R**esponse to **I**ron **E**nrichment **S**tudy - SERIES) was carried out in the eastern subarctic Pacific. These international collaborative projects between Canada and Japan were developed under the umbrella of PICES, through its Advisory Panel on *Iron Fertilisation Experiment*. Both experiments were successful and generated important new findings published recently in *Science* (SEEDS-I: Tsuda *et al.* 2003, 300: 958-961) and *Nature* (SERIES: Boyd *et al.* 2004, 428: 549-553). More detail results from these experiments will be published as special issues of primary journals in 2004/05. The latest joint Japan/U.S.A./Canada experiment in the western subarctic Pacific (SEEDS-II) was completed in August 2004.
- A 3-day workshop on "*In situ* iron enrichment experiments in the eastern and western subarctic Pacific" organized by the PICES IFEP was held February 10-12, 2004, in Victoria, Canada. Specific objectives of the workshop were (i) to synthesize results from two recent in situ iron enrichment experiments in the subarctic Pacific (SEEDS-2001 and SERIES-2002); (ii) to determine similarity and differences in biogeochemical and ecosystem responses to iron addition between eastern and western subarctic Pacific; and (iii) to identify specific scientific questions for the longer-term experiment in the western subarctic Pacific (SEEDS-2004). The workshop was attended by 25 scientists from Canada, Japan and U.S.A. A brief report on the workshop was published in PICES Press (Vol. 12, No. 2), and proceedings will be published in the PICES Scientific Report Series in October 2004.
- A 1½-day session on "Response of the upper ocean to meso-scale iron enrichment" was organized jointly by Canadian-SOLAS and PICES at the TOS/ASLO 2004 Ocean Research Conference (February 17-18, 2004, in Honolulu, U.S.A.). A brief report on the session was published in PICES Press (Vol. 12, No. 2).

Integrated Marine Biogeochemistry and Ecosystem Research (IMBER)

- PICES is interested in the development of a new project on ocean biogeochemistry and ecosystem research, and invited a representative of IMBER to give a programmatic talk at

PICES XIII and to discuss how PICES can assist in the implementation of this project in the North Pacific. Dr. Julie Hall will attend PICES XIII on behalf of IMBER.

Global Ecology and Oceanography of Harmful Algal Blooms Program (GEOHAB)

- All PICES member countries and Mexico have significant HAB problems, and similar levels of scientific uncertainty in regard to HABs that are severely limiting the ability to forecast and mitigate HAB events. For these reasons there is keen interest in sharing information from active science and management programs in each PICES member country. To achieve and maintain the appropriate level of coordination and collaboration among its member countries, PICES, instead of short-lived Working Group, decided to establish a longer lifespan Section on *Harmful algal blooms and their impacts*. This will provide additional opportunity for participation in the international collaborations that are currently underway, including such GEOHAB projects as "HABs in upwelling systems", "HABs in fjords and enclosed embayments" and "High biomass HABs in eutrophic systems".
- Monitoring and research activities aimed towards achieving effective HAB predictive and mitigation strategies are underway in each PICES member nation, in many cases dealing with similar organisms or problems. These efforts will benefit from building a common data resource among PICES nations that allow inter-comparison of HAB species composition and the magnitude of environmental and economic impacts. During the PICES XII workshop on "Harmonization of HAB data", national representatives accepted an offer to utilize the IOC-ICES successful harmful algal event database (HAE-DAT) format on a trial basis. The goal of the follow-up joint PICES/IOC workshop on "Developing a North Pacific HAB data resource" to be held at PICES XIII, is to provide an interim "report card" on the use of this database. The central tasks are: *1) Ascertain how well the database process worked. 2) Identify any difficulties in data delivery from member nations. 3) Assess the effectiveness of the interactive web-based window to the developing resource* and 4) *determine if further modifications are needed to encompass unique aspects of Pacific Rim marine resources.*

International Ocean Carbon Coordinated Project (IOCCP)

- IOCCP is working to develop a central information source of on-going and planned ocean carbon observations, and to establish international agreements on observation methods, best practices, data management, and data sharing that will lead to the joint development of global data products and synthesis activities documenting the ocean carbon cycle. PICES is acting as a regional coordinator for these activities.
- To foster international cooperation towards the integration and synthesis, IOCCP and PICES collaborate on developing the global database for CO_2 and CO_2-related data. An initial North Pacific data inventory (PICNIC - **PI**CES **C**O_2 Related Data Inventory in **N**orth Pacif**ic)** has been prepared following recommendations from two PICES CO_2 Data Integration Workshops and is now available on line at http://picnic.pices.jp (426 cruises by six PICES member countries). The PICES WG 17 on *Biogeochemical data integration and synthesis* will carry this task to ensure continuous updates and geographical expansion of the database.
- A joint IOCCP/PICES/NIES Workshop on "Ocean surface pCO_2 data integration and database development" was held January 13-17, 2004, in Tsukuba, Japan. This workshop,

which brought together 44 participants from 12 countries, was focusing on (i) the results of the inter-comparison experiment for ocean underway and moored pCO_2 systems, (ii) standardization of data and metadata formats, and (iii) data integration and networking. Detailed information has been posted on the IOCCP website (linked to the PICES website), and a brief report was published in PICES Press in July 2004 (Vol. 12, No. 2).

- A joint PICES/IOCCP Topic Session on "The impacts of climate change on the carbon cycle in the North Pacific" will be convened October 20-21, 2004, at PICES XIII. Special time will be allocated at the session to present the main findings from the NOAA/GCP/PICES workshop on "Understanding North Pacific carbon-cycle changes: Data synthesis and modeling" held June 2-4, 2004, in Seattle, U.S.A.
- IOCCP provided US $6,000 to PICES for the publication of the "Guide of best practices for oceanic CO_2 measurements and data reporting" being prepared by the PICES WG 17 on *Biogeochemical data integration and synthesis*, to ensure a large print run of the guide. Publication is expected in the *PICES Scientific Report Series* by the end of 2004.

WORKING GROUPS/PANELS SPONSORED BY SCOR

SCOR-IOC Working Group 119 on *Quantitative Ecosystem Indicators for Fisheries Management*

- The overlapping scientific interests of PICES and SCOR-IOC WG 119 resulted in PICES' involvement in planning and organizing the International Symposium on "Quantitative ecosystem indicators for fisheries management" held March 31-April 3, 2003, in Paris, France. PICES was represented on the Scientific Steering and supplied logistical support to get the Symposium organized by handling on-line registrations and submission of abstracts, producing the book of abstracts, staffing the Symposium Office during the event, as well as supporting the participation by some colleagues from PICES member countries. The Symposium attracted 250 participants from 43 countries, and a program included 40 presentations and close to 150 posters. The Symposium papers will be published as a special issue of the ICES *Journal of Marine Science* in late 2004. We anticipate that the special issue of the ICES *Journal of Marine Science*, due within a year, will present the major findings from the Symposium and will become a reference publication for the scientific aspects of using ecosystem indicators as part of an ecosystem approach to fisheries.
- PICES is developing a North Pacific Ecosystem Status Report: a pre-publication version can be found on our website (http://www.pices.int/publications/ecos_status/2004/npesr_2004.aspx). The report contains not just descriptive summaries of physical and biological conditions in the North Pacific but also quantitative indices of ecosystem status and trends. This effort is, and will remain, as a work-in-progress as new observations are made, new discoveries are reported, and new questions are asked. The report opens new opportunity for cooperation with the SCOR-IOC WG 119 that could assist in identifying what should be addressed in the North Pacific Ecosystem Status Report, using relevance to management decisions as selection criteria.

- Relevant activities in PICES also include WG 16 on *Climate change, shifts in fish production and fisheries management* which will produce a final report in early 2005, and a Study Group on *Ecosystem-based management science and its application to the North Pacific* (we expect that a new Working Group on this topic will be launched in 2004/05).

SCOR Working Group (proposed) on *Global comparisons of zooplankton time series*

- A workshop on "Climate variability, zooplankton abundance and distribution – comparative opportunities from the world's oceans" hosted at the 3rd PICES/ICES/GLOBEC Zooplankton Production Symposium (May 2003, Gijón, Spain) concluded that we are lacking comparisons of zooplankton population variability among the world's oceans, in contrast to such global comparisons of fish populations (a manuscript with the results and recommendations from the workshop was published recently in the *ICES Journal of Marine Science* issue devoted to the Gijón meeting), and led to a proposal submitted to SCOR for a Working Group on *Global comparisons of zooplankton time series*. At 2004 interim meeting, PICES Science Board supported this proposal and agreed to provide funding for one additional member (from PICES) to participate in this Working Group should it be accepted by SCOR.

SCOR TRAVEL GRANTS FOR MEETINGS ORGANIZED/SPONSORED BY PICES

- SCOR has supported past PICES Annual Meetings and special meetings (*e.g.*, "Beyond El Niño Conference on Pacific climate variability and marine ecosystem impacts" in 2000, and the 3rd Zooplankton Production Symposium on "The role of zooplankton in global ecosystem dynamics: Comparative studies from the World Oceans" in 2003) through travel grants for scientists from countries with "economies in transition". In 2004, SCOR provided a travel grant of $4,000 US for 1 Chinese and 1 Russian scientist to attend the PICES/IOC Workshop on "Developing a North Pacific HAB data resource" to be held in conjunction with PICES XIII.
- Two requests are addressed to SCOR:
  - PICES requests to support participation of scientists from countries with "economies in transition" from the Pacific Rim in the PICES Fourteenth Annual Meeting to be held September 30-October 8, 2005, in Vladivostok, Russia. The overall theme for PICES XIV, "Mechanisms of climate and human impacts on ecosystems in marginal seas and shelf regions", is of interest to SCOR (description of the PICES XIV Science Board Symposium is included in Appendix 1). The scientific program for PICES XIV will be finalized in October 2004, at the upcoming PICES Annual Meeting.
  - GLOBEC and PICES request to support participation of scientists from countries with "economies in transition" in the Symposium on "Climate variability and sub-arctic marine ecosystems" to be held May 16-20, 2005, in Victoria, Canada (extraction from the announcement for the Symposium is included in Appendix 2).

Appendix 1
Theme for PICES XIV:

"Mechanisms of climate and human impacts on ecosystems in marginal seas and shelf regions"

There are many examples of statistical correlations that demonstrate relations between climate or human impacts and ecosystems. While retrospection may be informative in revealing patterns, it rarely leads to mechanistic understanding required for eventual prediction. This Science Board Symposium on this topic instead will focus on physical and biological mechanisms in the marginal seas and shelf regions. Many coastal species have life histories/cycles that rely on specific geographic features and they may be particularly vulnerable to the effects of human activities and climate variability. In order to predict the impacts of climate and human activities we need to understand the mechanisms responsible for shifts in ecosystem structure and function. We will consider "wind to whales" in this session. This theme will provide opportunities to address questions such as: How widespread is bottom-up control of fluxes? At what spatial and temporal scales are: *(i)* trophodynamic demands and food supply in balance?, *(ii)* signals amplified in food webs? and *(iii)* physical processes most important in impacting marine populations? The human impacts that could be considered include, fishing and fisheries enhancement, changes in biodiversity, petroleum development, eutrophication, mariculture, non-point source pollution, and others.

Appendix 2
GLOBEC Symposium on "Climate variability and sub-arctic marine ecosystems"

Background and objectives
Sub-arctic seas support extraordinarily rich marine resources, which provide food and wealth to local communities. These seas include the Okhotsk Sea, Oyashio shelf region, Bering Sea, Hudson Bay, Newfoundland/Labrador shelves, Gulf of St. Lawrence, Greenland shelves, Iceland regions, the Nordic Seas and the Barents Sea. These seas share several features in common: seasonal ice cover, freshwater from ice-melt and runoff, dramatic seasonality, reduced sunlight and low biodiversity. Recently, changes in species abundance or distribution have been observed within several Sub-Arctic marine ecosystems. A symposium on climate effects on the Sub-Arctic marine ecosystems is timely because these recent changes appear to correlate with fluctuations in the physical environment, and because of the growing concern about anthropogenically induced climate change. Also, several new national programs in Sub-Arctic seas have recently been initiated, *e.g.* Bering Ecosystem Study (BEST), Effects of North Atlantic Climate Variability on the Barents Sea Ecosystem (ECOBE), Ecosystem West Greenland (ECOGREEN), and the Oyashio-pollock project in Japan. Additionally, a new GLOBEC regional program, Ecosystem Studies of Sub-Arctic Seas (ESSAS), is in the planning stage. This symposium offers the opportunity to influence the implementation plans of ESSAS and BEST.

Scientific program

The symposium's scientific objective is *to present current knowledge of the effects of seasonal to multi-decadal climate variability on the structure and function of Sub-Arctic marine ecosystems*. Papers, particularly inter-disciplinary or comparative ones, are invited on the following topics:

- large-scale climate forcing on the physical oceanography of Sub-Arctic seas;
- processes structuring Sub-Arctic ecosystems (sea ice, low temperatures, low species diversity, etc.);
- the transfer and fate of energy through subarctic food webs, from primary producers through zooplankton and benthic fauna to fish, seabirds, marine mammals and fisheries;
- recent changes in subarctic ecosystems, time scales of variation and possible causes;
- inter-comparisons between Sub-Arctic marine ecosystems.

Dates and venue

The symposium will be held May 16-20, 2005, at the Victoria Conference Centre in Victoria, British Columbia, Canada. May 16 will be a workshop for discussion of the BEST Implementation Plan, and May 21 will be an all-day workshop for developing the Implementation Plan of ESSAS. All symposium participants are welcome to attend these workshops. Local arrangements for the symposium will be coordinated by the PICES Secretariat.

Symposium structure

The symposium will have a combination of plenary sessions in the mornings, and parallel sessions in the afternoons. Keynote speakers will provide 40-minute introductions and challenges to selected topics. Contributed papers that are accepted will be 20 minutes in length. Posters will be displayed throughout the meeting, and sufficient time will be provided for discussion with authors. Workshops on BEST and ESSAS will be held on the first and last days of the symposium. The official language of the symposium will be English.