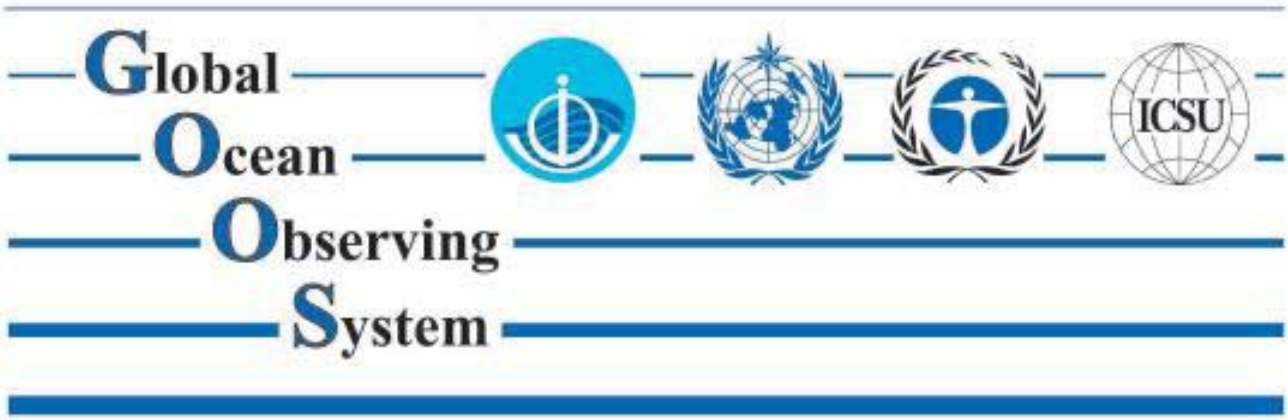

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

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IOC Workshop on the Establishment of SEAGOOS in the Wider Southeast Asian Region

Seoul, Republic of Korea
30-31 August 2001

GOOS Report No. 119

UNESCO

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This workshop was sponsored by
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Abstract

The workshop was held in conjunction with the Fifth IOC/WESTPAC International Scientific Symposium in Seoul, Republic of Korea during 27-31 August 2001. On 30-31 August individuals interested in establishing a global ocean observing system regional organization for Southeast Asia joined to discuss and plan this initiative. The workshop included 30 participants from Republic of Korea, China, Thailand, Vietnam, Australia, Japan, Indonesia, Malaysia, Singapore, Norway, United States and the Philippines. The workshop was planned by the IOC Perth Regional Programme Office in cooperation with the IOC/WESTPAC Secretariat.

First Admiral Hassan Rasip (Malaysia) served as its Chairman and William Erb (IOC) served as the workshop moderator. After a several background papers were presented participants provided presentations on their countries/agencies interests in GOOS and identified requirements for establishing a regional approach to ocean and coastal observations. The workshop was then divided into three working groups charged with drafting an outline plan for a regional observing activity. The working groups produced three outline plans for project activities in the following three areas: Coastal Dynamics and Pollution, Ecosystems and Fisheries, and Climate and Tropical Cyclones. Each working group was instructed to include in their reports the organizational requirements for establishing a regional organization.

The workshop recognized the importance of involving governments in the process of establishing the regional organization. It also noted the importance of individuals stepping forward to assume leadership of various activities in the interim period and lead-up to formal establishment of a SEAGOOS. Funding issues were discussed recognizing the need but realizing that much of the work required now is doable without a funding package in place.

The workshop produced a Workshop Statement endorsing the establishment of SEAGOOS, set up an Ad Hoc Working Group for SEAGOOS with a Terms of Reference and developed plans for three projects in the region.

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ANNEXES

1. INTRODUCTION

An Implementation Workshop for Establishment of SEAGOOS in the Wider South East Asian Region was held in Seoul, Republic of Korea during August 30-31. SEAGOOS translates into South East Asian Global Ocean Observing System. The workshop was part of a larger conference entitled "Ocean Sciences at the Dawn of a New Millennium-Fifth IOC/WESTPAC International Scientific Symposium" that was sponsored by the IOC Sub-Commission for the Western Pacific. The workshop was organized by William Erb, Head of the IOC Perth Regional Programme Office in Perth, Australia. He was assisted by Maarten Kuijper of the IOC/WESTPAC Secretariat in Bangkok. First Admiral Mohd Rasip bin Hassan agreed to chair the workshop as he had chaired a previous meeting to discuss SEAGOOS in 1998.

The workshop included thirty participants from IOC member states having an interest in developing a regional component of the Global Ocean Observing System in the South East Asia region. A number of invited papers were presented to provide background on GOOS and related activities presently occurring in the region. The presenters of papers also served as facilitators during the workshop to assist in the formulation of ideas and to provide advice during working group sessions.

The Global Ocean Observing System (GOOS) is expanding rapidly through the establishment of regional organizations such as EuroGOOS, NEARGOOS, PacificGOOS, IOCARIBE-GOOS, and others. These vary in characteristics and the workshop reviewed several of these organizations to identify examples for the development of SEAGOOS.

The stated objectives of the workshop were:

- Describe the rationale for GOOS and its defining principles.
- Identify the region's requirements for GOOS: Observing Systems, Data Types, Data Management, Modeling, Products and Applications.
- Define the benefits of a SEAGOOS.
- Identify mechanisms to sustain development of SEAGOOS.
- Identify other cooperative programs and activities.
- Discuss desirable characteristics of a SEAGOOS organization.

The workshop was organised into three parts:

- Plenary lectures to provide background on GOOS and potential pilot projects.
- National presentations on GOOS-related activities, interests and capabilities.
- Working groups.

The workshop produced a consensus statement suggesting that a SEAGOOS organization would be beneficial and that the participants would work towards that goal. The workshop also identified various necessary mechanisms to support the process, particularly a coordinating group to guide its development.

1.1 OPENING OF THE MEETING

The meeting was opened by First Admiral Mohd Rasip bin Hassan. He welcomed everyone to the workshop and expressed appreciation to IOC/WESTPAC, Ministry Of Maritime Affairs and Fisheries - Republic of Korea and the Korea Ocean Research and Development Institute for hosting

the workshop. He also thanked the U.S. Office of Naval Research (International Field Office – United Kingdom) for the funding assistance provided to organize the workshop.

Admiral Rasip reminded everyone that an ad hoc Consultation for SEAGOOS was held in Okinawa from 2-7 Feb 1998, during the previous WESPAC Scientific Symposium. That meeting agreed that there was a need for the establishment of SEAGOOS and discussed ways and means to develop SEAGOOS. It was then proposed that the project be tabled at the IOC/WESTPAC Sub-Commission meeting in 1999 and a draft resolution be prepared for the next UNESCO General Conference for special funding, following the NEAR-GOOS example. Regrettably no action was taken but the region remains interested in establishing an organization for GOOS.

He expressed the following views based on previous discussions:

- NEAR-GOOS could be a possible model for SEAGOOS.
- There is an urgent need for an open oceanographic data exchange in the region.
- Capacity building should be an essential component (IOC now has a document on "Principles of GOOS Capacity Building", for our use and reference).
- SEAGOOS should focus on limited and agreed parameters in certain geographic areas.
-

Also, he reminded participants that:

- GOOS is an integrated global network.
- It systematically acquires and disseminates data and products.
- It is to meet the information needs of government, science, industry and the public, in order to address marine-related issues and problems - in a timely fashion.

Admiral Rasip made the point that GOOS implementation and development has expanded through regional organizations, now referred to as GOOS-Regional Alliances (or GRAs). Examples are EuroGOOS, PacificGOOS, IOCARIBE–GOOS and Med-GOOS. These vary in characteristics, including organizational structure, status of members and funding mechanisms.

He encouraged the workshop to work towards a comprehensive document, which would lead to implementation of mutually beneficial pilot projects. To be successful he encouraged kind and full cooperation and deliberations that are frank, open and constructive.

2. ADMINISTRATIVE ARRANGEMENTS

The workshop sessions were administered by Dr. Sang-Kyung Byun (KORDI) and his staff. The Convention Center of Seoul National University Hoam Faculty House was the meeting site and also provided accommodation for many of the participants. The workshop took place over two full days (August 30-31) from 09:00 to 17:00.

The workshop planning was accomplished through a steering committee consisting of Maarten Kuijper, Modhd Rasip bin Hassan, Angus McEwan, Susan Wijffels, Naoyuki Hasegawa, Johannes Guddal, Tian Kuay Lim, Anond Snidvongs and William Erb (Chair). The aforementioned people except for Mr. Kuijper presented papers and served as facilitators during the workshop.

2.1 ADOPTION OF THE AGENDA

The provisional agenda (Annex I) was adopted by the participants.

2.2 DESIGNATION OF THE RAPPORTEUR

Mr. William Erb served as rapporteur for the workshop.

3. PLENARY LECTURES

3.1 WORKSHOP OBJECTIVES

By William Erb

Mr. Erb explained that workshop participants must have a clear understanding of what GOOS is about, why it was established, how it works and its organizational structure. This information is needed in deciding whether or not to get involved in setting up a regional GOOS and is largely available on the GOOS and IOC web sites. Regional GOOS policy, principles and organization must be clearly understood.

He explained that the Southeast Asia region has a number of projects and activities involving observing systems and related activities and that several of these would be presented as lectures and as examples. Others would be identified during the workshop. By knowing what exists and what is being planned it is easier to identify deficiencies and to determine the requirements for complete observing systems and product delivery. The Southeast Asia region should build on the experience of other regions that have established regional GOOS activities.

A benefit of GOOS is that the work and costs can be shared. GOOS activities are often expensive and in some cases technically difficult. To ascertain the benefits it is often helpful to develop inventories of existing capabilities and to define user needs. It is likely that the establishment of a SEAGOOS or even a plan to establish one will attract government interest. It is important to document the regional needs for environmental data and information. Common requirements and standards for data and products increase applicability and reliability. The user community must be engaged to help define the requirements and design the observing systems. Workshops can be utilized to achieve this.

Mr. Erb indicated various mechanisms that can assist in the development of regional GOOS organizations. First and foremost is identifying agreed objectives and goals. Leadership is a critical component that the workshop participants must assume. It can involve tasks as simple as communicating information. Other regional GOOS bodies have established steering committees, written strategies and implementation plans and encouraged the establishment of GOOS National Coordinating committees. MoU's can be helpful in establishing GOOS between countries or with IOC or other UN agencies. Funding issues are critical but this workshop will not solve that issue. Communication is perhaps one of the most important requirements for success. It is critical that information be exchanged and that an effort be made to stay in touch. Often an agency will volunteer to set up a small interim secretariat to sustain development of the organization. Developing flyers and web sites help. These and other mechanisms will be explored.

Linkages with other activities and organizations can often result in benefits. In this region ASEAN, APEC, GEF and UNEP are very active. Scientific projects sponsored by international agencies can provide the impetus required to establish regional observing activities.

Mr. Erb suggested SEAGOOS could consist of several sub-projects (or pilot projects) that work under the umbrella of a SEAGOOS secretariat or a steering committee. The sub-projects

could work with a high degree of autonomy using the secretariat for purposes of assisting in coordinating at a higher level. SEAGOOS could be governmental but it might initially begin with a more informal process and seek governmental endorsement at a later date. Sometimes governments prefer this approach because they are not committed to the result and this retains their flexibility and options. The relationship with WESTPAC and NEAR-GOOS should be considered from an organizational perspective. Membership by agencies or governments is an issue. One also must consider participation of other countries having a scientific or operational interest in the region and the ability to contribute. The issue of a charter or constitution and rules of procedure must be addressed. Thus, there are many issues to resolve in developing a regional GOOS and leaders are needed to make this happen.

Note: Mr. Erb later in the agenda provided an analysis of several regional GOOS organizations and suggested commonalities that the workshop should consider.

3.2 OVERVIEW OF GOOS ORGANIZATION, PRINCIPLES, OBJECTIVES AND BENEFITS

By Angus McEwan

Dr McEwan began his presentation with a diagram illustrating the way by which GOOS supplements and assists the conventional national processes for providing scientific information and advice concerning the oceans. The international GOOS framework gives access to global databases and generic products, while GOOS regional alliances provide focused and specific regional observing programs, quality control, regional modeling strategy, training and tools.

Using a second diagram he illustrated the organizational loop connecting a national (ocean) observing agency with the global intergovernmental framework (IOC), through a GOOS Regional Alliance (such as SEAGOOS) and the GOOS network, and returning to the agency via IOC Regional Sub-Commissions (such as WESTPAC) and national coordinating processes.

The incentives and disincentives for national bodies to participate in a GOOS Regional Alliance (GRA) were then itemized and discussed. It was noted that while there are many good reasons for organizing national ocean observing effort through a GRA, some effort may be needed to overcome obstacles arising from existing national policies and responsibilities. Acceptance requires an awareness of GOOS and good internal systems of communication and cooperation.

The structure of the internal GOOS organization was then briefly explained in terms of its governing committees and working groups and in terms of the functions and tasks of these bodies. These were then put in the context of the myriad of international organizations, programs and projects with which GOOS interacts and by which GRA's gain access and support from the global ocean community.

GOOS is intended to be a 'designed' system and participation implies an intention to comply with a number of broadly-defined 'principles', which were explained.

The presentation ended with a brief discussion of the draft policy governing the creation of GRA's, in the context of varying national requirements and capabilities.

3.3 THE INDONESIAN THROUGHFLOW: SCIENCE AND OBSERVATIONAL REQUIREMENTS

By Susan Wijffels and R Dwi Susanto

Dr Wijffels reported that the Indonesian Throughflow links the western Pacific warm pool, which is the seat of El Niño, to the tropical warm pools of the Indian Ocean where the Asian monsoon operates. The Indonesian Throughflow strongly influences the heat and freshwater budgets of these two oceans and therefore may be considered a key component in maintaining climate. Sea surface temperature patterns in both the Indian and Pacific Ocean are linked to variations in rainfall over Southeast Asia and Australia. Understanding what role the Throughflow plays in these phenomena and how it responds to them has been challenging in the past due to a lack of observations.

She stated that recent cooperation between Indonesia, Japan, France, Australia and the USA has produced great progress on these issues. Results of several programs were reported: JADE, a cooperative program between France and Indonesia whereby both mooring data and hydrographic sections were obtained within the outflow straits and the south east Indian Ocean; the World Ocean Circulation Experiment, where the USA and Australia performed hydrographic/tracer repeat sections between Australia and Indonesia; the TOGA-WOCE Repeat XBT lines which are maintained by Australia; and ARLINDO, a program between the USA and Indonesia which includes hydrographic sections and mooring work within the regional seas.

For a far more comprehesive summary of recent progress on the Throughflow, Dr. Wijffels recommended that participants should refer to Sprintall, et al., 2000.

Background:

The importance of the Indonesian Throughflow to the climate system was explored by Schnieder (1996) using a coupled climate model. His results reveal that by cooling the western equatorial Pacific and warming the eastern Indian Ocean, the Throughflow shifts the location of deep atmospheric convection (and associated high tropical rainfall) from the western Pacific eastwards to the Indian Ocean. This suggests that without the Throughflow, rainfall over Sumatra and Java would drastically decrease while that over the Philippines would similarly increase. Ocean only models (e.g. Hirst and Godfrey, 1993) reveal that the weakness of the East Australia Current, the comparative strength of the Agulhus Current and the very existence of the Leeuwin Current, are all due to the effects of the Throughflow. Clearly, this interocean flow impacts climate and oceans in the entire Eastern Hemisphere.

Judging the impact of the variability of the Throughflow (which is large, as we see below) on climate is still difficult, partly due to the remarkable fact that very few seasonal climate prediction systems include the Indian Ocean and the Throughflow. The lack of understanding of the importance of Throughflow variability on sea-surface temperature and thus climate is, however, also a result of a lack of an adequate observing system, both of the Throughflow itself, and of the Indian Ocean.

Some Recent Progress:

A synthesis of hydrographic snapshots of the Throughflow in the eastern Indian Ocean (Wijffels et al., 2001) reveal very large synoptic variability in the upper ocean transport and

structure of the Throughflow. A large part of this variability occurs at the intraseasonal time scale (40-80 days) as well as on seasonal and interannual timescales. Agreement between transports from CTD/XCTD sections and those derived from routine XBT monitoring suggest that the latter may be successfully measuring the long-term variability of the upper geostrophic component of the flow (Sprintall, et al., 2001). These XBT data also reveal the remote forcing of the regional ocean by both equatorial Pacific and Indian Ocean winds. A second estimate of the shallow geostrophic component of the Throughflow comes a shallow pressure gauge array reported by Chong et al., 2000, similary revealing large variability at many time scales.

A major weakness of the XBT time series is the lack of an estimate of the barotropic component of the flow, which may be substantial. Several mooring programs have been carried out in the various outflow straits (see Sprintall et al, 2000, for a summary) - all revealing strong variability. Unfortunately, few of these series overlap in time, meaning we have no complete estimates of the total Throughflow in hand, and this remains a large gap on our present knowledge.

Outstanding issues:

- Variability at intraseasonal through interannual is as large as the mean, hence the need for multi-year time series
- How typical are the 1996-98 Makassar results?
- Storage in interior seas requires 2-4 years simultaneous monitoring of inflow and outflow
- Deep Throughflow and barotropic part largely remains mysterious. A large intermediate water component could exist which may reconcile Island Rule predictions (15 Sv) with the observed modest shallow transport totals (5-10 Sv).
- Heat and freshwater fluxes into the Indian Ocean are still not well known
- Satellite data less useful in the internal seas; Tides need to be better resolved
- Timor shelf contributions: are they significant?

Suggested Future program:

- XBT/XCTD lines are likely most cost-effective means of monitoring volume and heat and freshwater flux: currently no use of XCTDs and need to instrument thermosalinographs on Ships of Opportunity.
- Obvious shortcomings in the ITF measurement programs is their lack of temporal coherence, hence, we need multi-year simultaneous coverage of:
- Inflow channels: Makassar and Lifamatola and Seram
- Outflow passages
- Indo-Australian Basin
- Develop cost effective, long term proxy-ITF monitoring:

There is ongoing modeling work of the ITF region by several groups, though the complicated and rough bathymetry remains a great challenge.

3.4 THE NEAR-GOOS EXAMPLE:

By Naoyuki Hasegawa

Dr Hasegawa explained that the North East Asia Regional GOOS (NEAR-GOOS) has been operated by China, Japan, Korea and Russia as a regional pilot program of GOOS. WESTPAC endorsed the program and established the NEAR-GOOS Coordinating Committee at its third

session (1996, Tokyo). The Committee finalized the "Implementation Plan for the Initial Phase of NEAR-GOOS", defining the initial objective of NEAR-GOOS as the establishment of real-time and delayed mode data bases. The Committee also prepared the Operational Manual for the NEAR-GOOS Data Exchange at its first meeting in 1996 and modified it at its third meeting in 1998. The data exchange mechanism consists of the real time and delayed mode data exchange streams, linked with each other, and each mode has a regional data base and national data bases to efficiently collect and provide the observational data, and to ensure the consistency in the coverage and the presentation of the data. The Japan Meteorological Agency and the Japan Oceanographic Data Center have been operating the NEAR-GOOS Regional Real Time Data Base and the Regional Delayed Mode Data Base, respectively. For further information on the current system, he suggested participants to refer to the operation manuals available at: http://ioc.unesco.org/goos/neargoos.htm.

He concluded by stating that the Coordinating Committee is now working on a medium term strategic plan based on the past experiences of the NEAR-GOOS operation and further needs of the data users. The extension of the types and the volume of the exchanged data would be considered as well as the provision of the data assimilation outputs as fundamental information for further applications solicited by various end users.

3.5 SOUTH CHINA SEA STORM SURGE, WAVE AND CIRCULATION FORECASTING PILOT PROJECT

By Johannes Guddal

Dr. Guddal introduced the concept of a series of rotating workshops aiming to discuss requirements for contemporary and professional end-to-end systems for operational storm surge, wave and circulation forecasting models in countries surrounding the South China Sea. The workshops will address both scientific and technical issues, such as meteorological forcing and ocean response, observations, numerical models and modes of dissemination of warnings.

The following issue would be considered:

- Definition and assessment of an optimal, regional ocean/meteorological observation network to serve ocean forecasting,
- Consideration of coordinated and shared sources of forcing and boundary data needed for ocean models, including the fine mesh description of typhoon wind fields,
- Exchange of ocean and marine meteorological data in the region,
- Coordination and shared sources of ocean remote sensing data, in particular gridded altimetry,
- Choice and use of numerical models,
- Shared experience and advice on the acquisition, deployment, operation and maintenance of ocean and marine meteorological observation technology,
- Other operational issues, such as hardware platforms for data management and models.

He noted that the proposal may be seen as a preliminary GOOS pilot project. The term ‘preliminary’ applies because, within a year or so, the GOOS Steering Committee will consider defining procedures for formal recognition of GOOS labeled projects.

JCOMM is considered to become ‘the implementation body’ for GOOS, and therefore the project can be seen as an example of JCOMM implementation assistance, under the terms of reference of the JCOMM subgroup on wave/surge forecasting, or as an example of contribution to capacity building. Further, the nature of surge/wave forecasting in the South China Sea region is

closely connected to systems for Tropical Cyclone forecasting in the area. Therefore, it also falls under the terms of reference for the Tropical Cyclone Program (TCP). The project should make all efforts to acquire synergy from this program.

Organizational responsibility should also be sought in the framework of SEAGOOS; perhaps the project could act as a stimulus to initialize the necessary regional cooperation.

The participation of National Meteorological Centers (NMC's) is also crucial, because they are primary candidates to take on operational services, and also have their own resources to supplement an oceanographic forecasting system. Consequently, they should take the responsibility of hosting individual workshops.

He therefore suggested that the series of workshops be organized as a joint venture between TCP and JCOMM at the international level, with regional support from WESTPAC/ SEAGOOS, and national support from NMC's.

Dr. Guddal stated that the work mode for the project would include:

- Annual, rotating workshops.
- First meeting held in Vietnam, jumping off from the recent project establishing storm surge and wave forecasting.
- Attendants: NMC's representatives charged with marine forecasting, systems providers, designated experts, and sponsors.
- Carefully selected lecturers and resource persons.

3.6 SOUTH EAST ASIAN CENTRE FOR ATMOSPHERIC AND MARINE PREDICTION (SEACAMP)

By Lim Tian Kuay

Dr Lim Tian Kuay explained the origin of the SEACAMP project. At its 19th Meeting in July 1996, the ASEAN Sub-Committee on Meteorology and Geophysics (ASCMG) deliberated on the SEACAMP project proposal. The members of the ASCMG are from the national hydro-meteorological and geophysical agencies of Brunei Darussalam, Cambodia, Indonesia, Lao P.D.R., Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. In late 2000, the ASEAN Committee on Science and Technology (COST) approved the project and the ASEAN Secretariat is now in the process to source for funding support for the project.

He noted that the SEACAMP project is to be implemented as 4 modular projects as shown in Table 1 below.

Table 1: Description of SEACAMP project

S/No	**Description of reformulated project Proposal**	**Budget (Host), US$**	**Budget (Donor), US$**	**Duration of Project**
I	ASEAN Network for Exchange of Data for Marine Meteorology and Oceanography	125,000*	126,200	10 months
II	Numerical Model Products for Marine Meteorology and Oceanography in ASEAN	96,000*	117,780	12 months

S/No	**Description of reformulated project Proposal**	**Budget (Host), US$**	**Budget (Donor), US$**	**Duration of Project**
III	ASEAN Enhanced Observation Network for Marine Meteorology and Oceanography	300,000*	2,370,100	18 months
IV	Establishment of a Center, SEACAMP	2,353,400*	3,990,000	28 months

* Budget includes contribution in kind.

Description of SEACAMP

Module 1

In this project, internet-based communication links will be established to facilitate the exchange and flow of marine meteorological and oceanographic data and products. The sources of the data will be from the national meteorological agencies and institutions in the region as well as from various advanced marine meteorological and oceanographic centers in the world. The existing ASEAN Specialized Meteorological Center (ASMC) will implement this project. Hardware and the relevant software will be provided to each of the members. Based on the findings from market survey, customized products and data will be generated for use and access by the members. This project is highly sustainable because the ASMC is already a self-sustaining operational Center.

Module 2

In this project, ASMC will source and adapt numerical models of the sea and ocean to cater for the requirements for the ASEAN region. ASMC will also organize a training attachment cum workshop on the use and interpretation of numerical model products for marine meteorology and physical oceanography. At the end of the project, ASMC will generate relevant operational products from these models for access by the ASEAN members. There is high sustainability and continuity for this project as ASMC is already an operational center with resources to operate and generate numerical model products.

Module 3

This project aims to enhance the observational network in the ASEAN region. This will involve the strategic upgrading of the existing MetOcean stations and the implementation, deployment and installation of data acquisition equipment and systems for 5 additional observing stations in the region. The marine observations collected by the enhanced network would include sea surface wind and ocean wave fields, sea surface temperatures, wave height, swell and period. These observations are critical to ASEAN countries in the provision of quality services in support of resource management, industrial development, shipping and fisheries, pollution monitoring and disaster mitigation, climate monitoring and research, and environmental protection.

Module 4

With the implementation of the first three modules, a number of strategically-located marine meteorological and physical oceanographic observation stations and facilities would have been established in the sub-region to provide ASEAN national meteorological and oceanographic agencies with crucial and quality data on a long-term basis. In module 4, a marine meteorology and physical oceanography center will be established operationally to provide the infrastructure support for the better monitoring, assessment, modeling and forecasting capabilities in ASEAN. This center would constitute a body within which data, predictions, know-how, experiences and products are developed and exchanged, thereby making available meteorological and oceanographic resources at the national level in support of resource management, industrial development, shipping and

fisheries, pollution monitoring and disaster mitigation, climate monitoring and research, and environmental protection in the ASEAN region.

Dr Kuay concluded by stating that the proposed center would maximize the use of existing staff, computing facilities and computer applications software, and equipment of national institutions. In addition, to permanent scientists, selected ASEAN staff would also be seconded to work in the center and help in its development. Experts from advanced countries would be invited to work in the center as part of the process of technology transfer.

3.7 INTERNATIONAL COOPERATIVE STUDY OF THE GULF OF THAILAND

By Anond Snidvongs

Dr Snidvongs reported that the International Cooperative Study of the Gulf of Thailand is a regional research programme for the sustainable management of the Gulf of Thailand. It is a technical network under IOC/WESTPAC and is hosted by the Southeast Asia START Global Change Regional Center (SEA START RC) at Chulalongkorn University in Bangkok, Thailand.

He reminded participants that the Gulf of Thailand is a marginal sea shared by Cambodia, Malaysia, Thailand and Vietnam. The Gulf on the one hand is rich in fisheries and mineral resources with obvious benefits to its coastal states. On the other hand, over-exploitation of resources and potential hazards due to navigation and offshore exploration and production of petroleum have raised concerns among scientists, policymakers and the general public alike. The basic oceanography of the Gulf of Thailand must be well understood if one wishes to be able to manage the Gulf's natural resources for sustainable use and to mitigate any adverse effects or offset any potential hazards to the Gulf's environment.

In terms of data and information services, the project offers the following services:

- Oceanographic station data collected in the Gulf since 1929 (a total of 5,022 stations). All these station data contain at least profiles of salinity and temperature, but several stations also provide other variables such as oxygen and nutrients. General meteorological conditions at the stations are also recorded.
- Surface current from ship drift records between 1900-1974 at 15139 stations.
- High resolution CTD data since 1996 at about 200 stations.
- Interactive on-line tidal prediction at coastal stations around the Gulf.

The project also maintains a large remote sensing archive including Topex/Poseidon altimetry, SeaWiFS, Landsat, and MODIS for parts of the Gulf.

In addition to data services, the project has conducted several capacity building activities for the region, particularly in the area of oceanographic data management. The IOC-IODE Toolkit is one of the materials used in the projects training workshops.

The project has maintained very good relations with oceanographic research and operational agencies in the four coastal countries—Cambodia, Malaysia, Thailand and Viet Nam. Oceanographic data and information exchange among agencies in these countries has increased over recent years. However, the level of such exchange is still not at the level that can be called operational. It is suggested that some formal commitments among these countries as well as a regional institutional framework are needed to facilitate such operational activity and the project is willing to cooperate with such regional initiatives.

4. PRESENTATION OF NATIONAL ACTIVITIES

The representatives of China, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam presented reports on their interests in GOOS including descriptions of their national marine science structure, observing systems, projects and requirements. These are included in ANNEX II of this report.

5. WORKING GROUPS

The participants discussed in plenary the modalities for setting up the working groups and the topics to be discussed. Their preference was to address topics without being geographic-specific. Three working groups were formed to address the following issues: Climate and Tropical Cyclones, Coastal Dynamics and Pollution and Ecosystems and Fisheries. They were charged with selecting their own chairperson and spokesperson. It was agreed that periodic reports back to plenary, to assess progress and to allow a cross-pollination of ideas, would be useful.

The final results of the working groups were presented to the plenary by working group spokespersons. The plenary also decided on a workshop statement calling for the establishment of a regional GOOS organization, establishment of an ad hoc working group for SEAGOOS and its terms of reference.

Each working group was requested to address the following points in their final report back to plenary:

- Observing System Capabilities, Needs and Deficiencies
- Geographical Areas of Interest
- Existing Projects
- Possible Projects
- Potential Products and Applications
- Data Management Issues (exchange & management)
- Potential Users
- Capacity Building
- Organizational Issues: MOU, Steering Committee, Secretariat, Workshops, Strategy Paper, Upcoming Meetings
- Resources
- Prediction & Forecasting
- Issues for other Groups

5.1 WORKING GROUP - 1: CLIMATE AND TROPICAL CYCLONES WORKING GROUP REPORT

Attendees:
Fredolin T. Tangang (National University of Malaysia)
Balotro Rolando S. (DMO-University of the Philippines)
Lim Tian Kuay (Meteorological Service Singapore)
R. Dwi Susanto (LDEO-USA/BPPT Indonesia)
Johannes Guddal (Norwegian Meteorological Institute)
Qu Qinong (State Oceanic Administration, China)
Susan Wijffels (CSIRO Marine Research, Australia) - reporter.
Bui Dinh Khuoc (Marine Hydrometeorological Center-Vietnam)

Summary:

The group agreed to consider 'long term' climate issues, and 'shorter term' climate issues (e.g. tropical cyclones) separately, and to have a 'free discussion' along these lines under each discussion item. In the perspective of an upcoming SEAGOOS, it is perhaps appropriate from this discussion to point out a few priority issues:

- A Memorandum of Understanding (MoU) is needed, probably preceded by an interim coordination committee.
- Capacity Building must be of high priority, and well targeted.
- A set of pilot projects will facilitate the planning and implementation process.
- Reduction of Natural Disasters must be a prominent goal.
- User communities must be identified and approached.

Needs and Deficiencies

Climate

The group commented that for long-term climate issues, there is a need for seasonal/interannual forecasts with specific emphasis placed on the likely occurrence and intensity of haze and droughts. It was further argued that dynamical forecasts are superior to statistical approaches, which supports the need to enhance the ocean observing system in the SEAGOOS region, including sub-surface information. In this regard, the group considered the region's contribution to a program such as Argo. The group concluded that the region is lacking long-time series and at present has only a limited observing system in place.

Tropical Cyclones

Better wind field predictions are needed, particularly so since satellite wind scatterometers are infrequent in their coverage. Other deficiencies relate to the need for better and more information on storm surges, large rainfall events (flooding) and large swell. The need for more wind measurements can be met by re-deployment of buoys, and more extensive use of VOS and radar (nearshore). It was further noted by the group that warnings could greatly improve with a better understanding of the societal impacts of cyclones, e.g. through inundation maps, knowledge on population densities, etc.

Current capabilities

Climate

The current capabilities in the field of climate forecasting lie primarily in the area of understanding and predicting monsoon variability. The notion prevailed that remote sensing is already operational and large data sets are produced. There is also some ground work done under the SEACAMP initiative and the "ASEAN/IRI/NOAA Seasonal climate forecasting project through the ASEAN Specialized Meteorological Centre based in Singapore. It was further comments that the OOPC supports the establishment of time-series, but at present there are no plans to establish a time series inside the SEA GOOS region.

Tropical Cyclones

At present, the Japan Meteorological Agency (JMA) provides wind field, and storm parameters, which feed into an ocean model to forecast storm surge for the region.

Geographical areas

Geographic considerations constitute an important factor. With respect to long-term *climate* predictions, it is important to realize that countries are affected differently depending on their geographic location. Similarly, *tropical cyclones* bring about different effects depending on whether they occur near the equator or not.

Existing projects

Climate

The group identified a number of existing projects in the region that support long-term climate forecasting, amongst these the SEACAMP – Seasonal forecasting project, OOPC activities and the Argo float program. It was further argued that any efforts in SEAGOOS should to the extent possible link to the global GOOS programs, notably: the Coastal Ocean Observing Panel (COOP), the Ocean Observing Panel for Climate (OOPC) and the GOOS Products and Services: Electronic bulletin and GOOS Climate capacity building programs.

Tropical Cyclones

The Tropical Cyclone program carried out under the auspices of the WMO provides training and coordination for the countries in the SEAGOOS region.

Possible projects

Climate

Three possible projects were identified by the group, those being:

1. A project to assemble and subsequently synthesize tidal data with a high-resolution model.
2. A project to enhance the observing system with a view to monitoring monsoon and climate variability, including the deployment of ocean buoys, floats, etc.
3. A project aiming to monitor the Indonesian and monsoon throughflows, and compare these with models and ocean prediction systems.

Tropical Cyclones

A possible project proposed in the field of tropical cyclones would be the organization of workshops aimed at capacity building for operational wave/storm surge forecasting.

Potential products and applications/users

Climate

The group suggested three different types of products related to the long-term climate issues, those being:

1. Trends
2. Forecasts (6-12 months)
3. Impacts of climate variability

Potential user communities of these products include those involved with coastal zone management, environment ministries and water resources development and management authorities.

Tropical Cyclones

Tropical cyclone forecasting would benefit from an ability to produce warnings of the intensity and magnitude of up to 5 days.

Data Management

Climate

The group argued that SEAGOOS should start with the existing national data management arrangements as much as possible, and the possibility of a linkage between SEACAMP and SEAGOOS on the issue of data management and exchange should be explored. It was further suggested that following the NEARGOOS example, one of the local GTS nodes could be asked to download ocean data from the system and make it available to SEAGOOS via an internet server.

Tropical Cyclones

The Tropical Cyclone Program (WMO/IOC) already provides the necessary infrastructure for data management in the field of tropical cyclone forecasting, but warnings could greatly improve from the assemblage of sea level data.

Capacity Building

Tropical Cyclones

As previously mentioned with respect to tropical cyclones, there is a need for capacity building workshops for operational wave/storm surge and forecasting. Other forms of assistance should also be considered in the implementation of forecasting systems.

Organization

The group suggested that in order to further SEAGOOS, it is advisable to draw up a MoU, which will facilitate the initiation of project under an umbrella framework, as well as to consider the establishment of an interim-coordinating group before the SEAGOOS program is officially launched. The interim secretariat could temporarily be attached to an existing IOC establishment, e.g. in Bangkok.

Upcoming meetings/opportunities

Three upcoming meetings that were considered relevant to the development of a climate and typhoon forecasting component under SEAGOOS include:

- Third Meeting for the Preparation of the GOOS Coastal Ocean Observing Panel Design Plan (COOP III), 15-18 January 2002 and associated GOOS User Forum and J-COMM Training Workshop on Typhoon Forecasting in the South China Sea region, 21-24 January 2002, Hanoi, Vietnam
- Pan Ocean Remote Sensing Conference 2002, 3-6 September 2002, Bali, Indonesia
- Fifth Session of the IOC/WESTPAC Sub-Commission, 9-13 September 2002, Fremantle, Australia

Strategy

In view of the foregoing, the working group suggested the following activities to be undertaken in support of the development of a climate component under SEAGOOS in the region:

- A review of current activities and capacities. Identification of gaps.
- In relation to Argo/GODAE, analyse how the ocean forecast information can be used and applied to real needs. Support should be sought from international organizations and a linkage should be made with users, else there is no long-term viability.
- The initiation of some comparisons of available ocean hindcasts/ forecasts (e.g. US Navy model output) and synthesis of these outputs with available local data.

Action item

As an immediate action, the working group proposed that the possibility of a linkage between SEACAMP and SEAGOOS be explored on the issues of data management and data exchange, and to report the progress within the next few months.

5.2 WORKING GROUP -2: COASTAL DYNAMICS AND POLLUTION

Attendees

Jan Sopaheluwakan (Indonesian Institute of Science)
Anond Snidvongs (Chulalongkorn University, Thailand)
Cesar Villanoy (MSI, University of the Philippines)
Nguyen Manh Hung (Institute of Marine Mechanics, Hanoi)
Mohamad Nor Said (Universiti Teknologi Malaysia)
Zhu Wen Xi (SOA, China)

Summary

The working group on coastal dynamics and pollution raised four topics of interest, those being: ocean circulation, wave transformation in the nearshore environment, sediment and pollutant transport and fate, and storm surges. From the outset, it was recognized that remote sensing and models were essential tools in each of these areas. The working group decided to focus primarily on physical and chemical aspects.

Geographical areas of interest

The group started off with a discussion of the criteria for choosing the study areas, which were twofold:

- The complexity of the issue under consideration, for instance in relation to coastal erosion/accretion processes, pollution (organic, land-based sources, mine tailing, eutrophication), past climate records, navigational problems (e.g. shallowing of the mud bottom).
- Considerations of what makes a reasonable geographical extent, with particular emphasis on the cost-effectiveness, technical feasibility and the availability of data and information from existing projects.

On the basis of these considerations, the group suggested that the following areas are promising:

- Gulf of Thailand
- South China Sea
- PEMSEA Areas
- Straits of Malacca
- Gulf of Tonkin (pollution hotspot, erosion)
- Jakarta Bay (pollution hotspot, erosion)

Existing projects

Examples of some international projects that have coastal dynamics and pollution components in them are:

- International Cooperative Study of the Gulf of Thailand (IOC/WESTPAC, SEASTART-RC)
- UNEP/GEF Project: “Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand” (involving demonstration projects targeting coastal habitats, pollution and fisheries).
- Jakarta Bay (Coastplan -An ICZM Demonstration Project carried out under the auspices of the CCOP aiming to provide the geophysical basis for planning purposes)

- PEMSEA: Partnerships in Environmental Management for the Seas of East Asia (with multiple ICM and risk assessment demonstration sites throughout SE Asia.
-

It was noted that these international projects were mostly related to coastal management and assessment, with little or no monitoring and observation aspects considered.

There are several national projects conducting real time observation that can be linked to SEAGOOS. These are carried out on an operational basis by the following agencies:

- Meteorological agencies
- Environmental and public health agencies
- Oceanographic and hydrographic services
- Port and harbor authorities

Potential users

Four general categories of potential users of SEAGOOS were identified.

4. Government, corresponding to the following sectors: environmental agencies, fisheries, hydrology and meteorology, coastal management agencies, water supply agencies, local municipalities, tourism development boards, public health, defense, energy generation, and wildlife conservation
5. Private Sector, notably fisheries and aquaculture, tourism industry, energy companies, and maritime industries
6. Research and education communities
7. International agencies

Proposed projects

The working group suggested two different directions that might be pursued within the context of coastal dynamics and pollution within SEAGOOS, those being:

8. A project focusing on the observation and modeling of coastal hydrodynamics. This would require inputs from other groups, such as a regional climate model, a watershed model and ocean circulation and wave models.
9. A project focusing on coastal sediment and pollutant transport, based on:
   - Coastal water quality monitoring and modeling (includes eutrophication, toxic chemicals, oil and organic pollution)
   - Coastal sediment transport (includes land-based sources of sediments, coastal erosion and accretion)

Potential products and applications

Coastal hydrodynamics observation and modelling:

- Daily coastal circulation and wave (policy concept)
- Forecasting of circulation and waves

Coastal sediment and pollutant transport:

- Daily dispersion potential of sediments and pollutant
- Forecasting of sediments and pollutant concentration (incl. plankton, chlorophyll and nutrients)

The group also considered the form that these outputs can take (be they in hard copy, digital forms or others):

- Real time and delayed mode data
- Maps
- Tables

- Grid point values
- Customized products (user-oriented recommendation, e.g. showing seasonal variations)
- Web-based access and distribution

Observing System Capabilities, Needs and Deficiencies

Among the existing observing system capabilities recognized by the working group are:

- Remote sensing assessment and GIS integration (incl. radar satellite)
- GPS positioning
- Satellite ground receiving stations
- Circulation and transport modeling (incl. chemical and ecological)
- Web-based map publishing
- Existing buoys and coastal stations
- Monitoring ships and vessels (R/V and voluntarily observation ships)

In terms of needs, the group called for:

- Higher (temporal and spatial) resolution monitoring systems (e.g. HF radar, Ikonos)
- Improved software and hardware to manage large volumes of data and information
- Larger band-width for data transfer

In terms of deficiencies, the group noted that the observational capability is constrained by:

- Obsolete and inappropriate technology for ocean observation
- Insufficient intercalibration (poor data QA/QC, esp. for chemical data)
- Insufficient trained manpower

Prediction and forecasting

At present, prediction and forecasting in the region is based on:

- Various regional ocean circulation and wave models (esp. South China Sea)
- Limited, localized water quality modeling in some countries
- Oil spill prediction models
- Shore evolution models (seasonal and localized)

However, the status of these tools demonstrate the need for:

- Calibration and validation of models
- Downscaling/nesting of regional circulation models to local models
- Upscaling of local models (water quality, sediments and pollution) into regional models
- Standardization and integration of local models

Data management issues (exchange and management)

Important data management considerations that were raised, were:

- The need for an agreement on data exchange policy, clarifying:
  - Data maintenance
  - Custodianship
  - Centralized versus distributed data centers
  - Data access and distribution
- Larger band-width for data transfer between agencies and/users
- Insufficient intercalibration (poor data QA/QC, especially for chemical data)

Capacity building

The region would greatly benefit from capacity building activities, including:

- Short term and degree training on:
- Observation
- Modelling
- Forecasting
- Data management
- Application
- Product development
- Uses of products
- Provision of instrumentation for operational observation and data processing
- An incentive system to ensure that the younger generation is interested in pursuing a career in operational oceanography and the development of SEAGOOS

Resources

On the basis of the foregoing discussion on needs, the working group suggested the following resource requirements:

- Initial start up funds from external sources (e.g. IOC/WESTPAC, WMO, other non-binding sources)
- Endowment funds for long-term operational observation (from respective governments)
- Resources to support in-house capacity building

Organizational issues

Linked to the aspect of resources are the organizational requirements. The working group considered it important to have:

- Appropriate institutional strengthening to sustain the project, including the establishment of:
  – A secretariat and national representatives (focal points)
  – A steering committee and subcommittees on technical issues
  – Regional centers and linked national centers to provide services to member countries
- Intergovernmental binding agreement (ASEAN+, IOC, etc.)
- Regular meetings and workshops (WESTPAC, PORSEC, others)

Issues for other groups

The coastal dynamics and pollution component of SEAGOOS would greatly benefit from:

- Regional climate model
- Watershed model
- Ocean circulation and wave models
- Compatibility at different geographic scales of models of the participating groups
- Data access and exchange with other groups
-

Strategy

In light of the foregoing, the working group proposed a three-pronged approach:

- Develop basic strategy and implementation plan, based on:
- A step by step approach, beginning from the existing network
- Transparent project operation for member countries
- Involvement of the stakeholders during and beyond the planning stage

- Voluntary contribution by each country and users
- Full and open access to data, information and products
- Establishment of clear guiding mechanisms for project implementation
- Public awareness to key stakeholders
- Policy makers
- Potential commercial users
- General public
- Financial strategy for the sustainability of the projects
- Sustained governmental support
- Seek partnership with private sectors

Next steps

- Establish the regional ad hoc groups, which will comprise of national nominees and experts, appointed by the respective IOC focal point in each of the participating countries.
- Briefing materials from the WESTPAC and GOOS Office to champion the program in respective countries
- Develop an implementation plan of the initial phase by the ad hoc group in close consultation with relevant national authorities
- Secure financial support for around 3 meetings of ad hoc groups
- Submit the draft of implementation plan of the initial phase for consideration and approval at the Fifth WESTPAC session (Fremantle, September 2002)
- WESTPAC Session should establish an intergovernmental committee on SEAGOOS endorsed by all member countries
- Champion the SEAGOOS to decision makers in each country
- IOC/WESTPAC should provide a consultant to assist in developing the implementation plan of the initial phase

5.3 WORKING GROUP -3: ECOSYSTEMS AND FISHERIES

Attendees

Miguel D. Fortes (University of Philippines)
Melati Ferianita Fachrul (Faculty of LAEE, Indonesia)
Dinh Van Vu (Vietnam National University)
Dang Ngoc Thanh (National Center for S&T Vietnam)
Angus McEwan (BOM Australia)

Summary

The group suggested the development of a project entitled “application of ocean observing system data and specialized observations to ecosystem assessment in the South China Sea”. The proposed project is a multi-lateral cooperative effort to link ocean and marine science to policy in the management and protection of the coasts of the South China Sea. It will address the environmental causes of economic loss due to natural and human-induced disasters and degradation of critical ecosystems upon which most of the economically important fisheries and sources of livelihood of people around the area depend. It proposes to achieve these ends through an assessment of sensitivity of selected coastal habitats and their associated fisheries to environmental variables using ocean observing systems largely and currently available in the area and validation of data through vectored experiments to come up with relationships and threshold values useful in resource management models. The project is a pioneering approach to the linking of large-scale

observing networks to ecosystem consequences at small scale, leading to policies and management tools that are strongly grounded on highly reliable, high quality scientific data.

Sub-projects

- South China Sea Ocean Database for Living Marine Resources application.
- Assessing and Forecasting the Recovery of Stressed Coastal Ecosystems.
- Effects of UV on Tropical Ecosystems as Bio-indicators of Ecosystem Health and for Rapid Assessment of Climate Change.

Sub-Project 1: South China Sea Ocean Database for Living Marine Resources Application Rationale/Objectives

- To provide basic information on the physical, biological and chemical oceanography of the South China Sea for potential users in the Southeast Asian region, using archived and real-time data sources.
- To apply the knowledge in marine and fishery monitoring and prediction (e.g. location of fish stocks, fish migration routes, high productivity areas, fish larval dispersal and recruitment, etc).
- To apply in the monitoring of aquaculture-related activities e.g. mangrove area loss, siltation, etc.
- To make an inventory of living organisms related to fisheries in order to establish a database.

Sub-Project 2: Assessing and Forecasting the Recovery of Stressed Coastal Ecosystems Rationale/Objectives

- To formulate models predicting and forecasting the resilience of coastal ecosystems of the South China Sea to increased pressure from both human activities and natural factors, and their recovery following release of these pressures.
- To integrate these models in general oceanographic models for the integrated management of the region's coastal resources especially fisheries.
- To conduct broad-scale and detailed field studies in selected coral reef and seagrass ecosystems, verified through experimental manipulations, to formulate sub models predicting the resilience and recovery of: habitat, communities and the economically important food webs supported by the plant communities.
- To integrate the knowledge acquired into a model predicting the resilience and recovery of coastal ecosystems in the South China Sea for improved fishery production.

Sub-Project 3: Effects of UV on Tropical Ecosystems as Bio-indicators of Ecosystem Health and for Rapid Assessment of Climate Change

Rationale/Objective:

- To study climate-related factors (e.g. UV and temperature) on reef systems, with particular attention to important marine species.
- To identify suitable and important sensitive species as bio-indicators or early warning systems for ecosystem stress and as tools for rapid assessment of climate change.
- To study the susceptibility of fish larvae and juveniles to UV.
- To study the susceptibility of other marine organisms to UV in their various life cycles.

Issues to be addressed

- Loss and degradation of coastal habitats.
- Loss of biodiversity.
- Decline in fisheries.
- Decline in water quality.
- Use of inappropriate technology.
- Lack of knowledge.
- Cultural insensitivity.
- Enhancement of coastal management capability through science.

Potential Participants

China, Vietnam, Thailand, Malaysia, Singapore, Indonesia, Philippines

Observing system capabilities (common to 3 sub-projects)

- National and international data archives.
- C-GOOS program elements.
- Argo Program
- JOMSRE (Joint Oceanographic and Marine Research Expedition: Vietnam and the Philippines).
- GOT, ITF, national remote sensing capabilities, Packard Seagrass Monitoring, NOAA, NASA Remote Sensing Programs, Reef Check, UNEP, Regional Seas Project, GEF, JSPS, Ocean Color.

Needs and Deficiencies

- Baseline data.
- Research personnel exchange.
- Sharing of laboratories, equipment and other resources.
- More ARGO floats.

Geographical Areas of Interests

- Selected zones in the South China Sea.

Existing Projects

- Global and Regional Programs: ICRI, ARGO, JOMSRE (currently not coordinated).
- National Projects.

Potential Products and Applications

- SCS Ocean Data Base, maps, remotely sensed images of habitats, spatial-temporal. distribution of fish stocks, predictive models of ocean processes, bio-indicators of ecosystem health, environmental quality criteria or sensitivity indices.
- Environmental management indicators.

Data Management Issues

- Data exchange.
- Format for integration.

Potential Users

- Environment, Fisheries, Science, Tourism sectors.
- Navy
- Private maritime, transport and oil and gas industries
- Marine park managers
- Policy makers.
- Government departments.
- Academics
- Etc.

Capacity-building & Maintenance

- Postgraduate fellowships.
- Regular workshops.
- Specialized training courses.

General Organizational Recommendations

The group suggested the establishment of an *ad hoc* planning committee to develop the project proposals to a stage suitable for presentation to the Fifth Session of IOC/WESTPAC. They further recommended one sessional meeting, with scientific experts from South China Sea littoral countries. A chair needs to be nominated. The proposal can be developed and refined by e-mail correspondence.

And following the consideration and formal endorsement of the IOC/WESTPAC Sub-Commission:

- Steering Committee formed with governmental representation. Chair appointed by WESTPAC. Responsible for developing detailed scientific and implementation plan for sub-projects.
- MoU drafted by Steering Committee, signed by participant countries.
- Duplication/coordination with existing GEF funded SCS projects: Check and resolve potential difficulties.

Resources Needed

- Funding, Instrumentation and Expertise.

6. PLENARY SESSION

The final results of the working groups were presented to the plenary by working group spoke-persons. The participants agreed that the results of the working groups fully reflected their collective interests. They also stressed that work on the pilot projects should begin immediately and that the Pilot Project Leaders would be all those people who participated in the individual working groups. A terms of reference for an *Ad Hoc* Working Group for SEAGOOS was agreed as follows:

Ad hoc Working Group for SEAGOOS

Terms of Reference

- Further SEAGOOS development in consultation with governments.
- Prepare MoU and other guiding documents.
- Publicize SEAGOOS plans and interests.

- Coordinate Pilot Project development with Pilot Project Leaders.
- Consider various sources of funding.
- Liaise with GOOS and other bodies as appropriate.

The participants also agreed that a workshop statement was necessary to ensure that others fully recognized the agreement to establish SEAGOOS in the region. The statement follows:

SEAGOOS Workshop Statement

The workshop participants strongly supported the creation of an organization (SEAGOOS) for the multilateral development of coordinated ocean observing systems and associated projects and activities in the South East Asian region. The participants agreed to assist in the development of plans for systems and projects undertaken by the organization, and encouraged WESTPAC to formally endorse SEAGOOS as a 'GOOS Regional Alliance' in accordance with GOOS principles and policies. To advance the planning of pilot project activities, the workshop proposed the immediate establishment of a WESTPAC ad hoc Working Group for SEAGOOS.

Participants requesting membership on the Ad Hoc Working Group include: Miguel D.Fortes, Jan Sopaheluwakan, Liam Tian Kuay, Mohd Rasip bin Hassan, Dang Ngoc Thanh, Fredolin T. Tangang, Yu Zhouwen, Zhu Wenxi, Lin Shaohua, Susan Wijffels

It was agreed that First Admiral Rasip would serve as the interim Chairman of the Ad Hoc Working Group for SEAGOOS, up to and including its first meeting. At that time he may continue or be replaced. The participants recognized that most of the group's work could be accomplished by email and that it would look for opportunistic events such as the WESTPAC Meeting in 2002 for meetings.

7. CLOSURE

The workshop was closed by First Admiral Rasip bin Hassan who thanked the participants for their hard work and for contributing to the excellent results. He noted that a good start had been made and that SEAGOOS could benefit the region, contribute to GOOS and be of assistance to individual countries. He also thanked the local organizing committee and the presenters for their contributions as speakers and facilitators. Finally, he noted that the sponsorship of the U.S. Office of Naval Research was greatly appreciated and made possible the wide participation.

Special appreciation and recognition is given to the Government of the Republic of Korea, especially the Ministry of Maritime Affairs and Fisheries and the Korea Ocean Research and Development Institute. Under the leadership of Dr. Sang-Kyung Byun of KORDI, the workshop was provided all the necessary support for its success and he and his staff made everyone content and comfortable.

ANNEX I

AGENDA

Implementation Workshop for Establishment of SEAGOOS in the Wider Southeast Asian Region
30 – 31 August 2001

1. OPENING

2. ADMINISTRATIVE ARRANGEMENTS

2.1 ADOPTION OF THE AGENDA
2.2 DESIGNATION OF THE RAPPORTEUR

3. PLENARY LECTURES

3.1 WORKSHOP OBJECTIVES (William Erb)
3.2 OVERVIEW OF GOOS ORGANIZATION, PRINCIPLES, OBJECTIVES, AND BENEFITS(Angus McEwan)
3.3 THE INDONESIAN THROUGHFLOW: SCIENCE AND OBSERVATIONAL REQUIREMENTS (Susan Wijffels and R. Dwi Susanto)
3.4 THE NEAR-GOOS EXAMPLE (Naoyuki Hasegawa)
3.5 SOUTH CHINA SEA STORM, WAVE AND CIRCULATION FORECASTING PILOT PROJECT (Johannes Guddal)
3.6 SOUTH EAST ASIAN CENTRE FOR ATMOSPHRIC AND MARINE PREDICTION (SEACAMP) (Lim Tian Kuay)
3.7 INTERNATIONAL COOPERATIVE STUDY ON THE GULF OF THAILAND (Anond Snidvongs)

4. PRESENTATION OF NATIONAL ACTIVITIES

Presentations by representatives from China, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam

5. WORKING GROUPS

6. PLENARY SESSION

7. CLOSURE

ANNEX II

NATIONAL REPORTS

China

by Zhu Wenxi

In China, ocean observation is the basic means of providing people with an accurate description of the present and future conditions of the ocean environment. It also contributes to the ocean management, marine resources exploitation and utilization, natural disaster mitigation and marine economy development. The ability to conduct ocean observations has a direct effect on marine resources development and environmental protection.

China has been attaching great importance to the work of ocean observations. After more than 30 years of hard work, the State Oceanic Administration which is responsible for national ocean observations has set up a three-dimensional ocean observation system consisting of coastal and island observation stations, platform observation stations, coastal radar station, data buoys, ships, planes and satellites. A great amount of data has so far been collected.

Coastal and island observation stations

More than 70 stations were established in the coastal area and islands covering from the mouth of Yalu River to the Nansha Islands in the South China Sea with the goal of long term and continuous observation. The oceanographic data collected are tide, wave, temperature, salinity, sea ice, meteorology, water quality, sediments and biologal parameters. To date, nearly 10 million US dollars has been invested in the upgrade of the observation equipment. Automatic observation was realized.

Marine data buoy

Twelve buoys have been placed into operation since the 1980's. There are 3 buoys deployed respectively in the Yellow Sea, East China Sea and South China Sea with the goal of long-term observation. The main parameters are wind, air temperature, air pressure, water temperature, wave and current. These are transmitted to the ocean forecasting center 8 times per day.

Remote sensing

SOA has two planes with remote sensing equipment, by which to carry out the monitoring and observations including red tide, oil spills and sea ice. SOA has set up several Satellite ground receiving stations in Beijing, Qingdao, Shanghai, Hangzhou, Guangzhou and Hainan, which can receive meteorological and oceanographic data useful for forecasts of disasters such as storm surge and red tide.

Ship observation

Ship observations are of several types: fixed site observation, profile observation and voluntary ship observation. SOA has established 400 marine sites and carries out yearly sampling and observations at fixed sites by a variety of ships. The parameters include oceanographic physics, chemistry, biology and meteorology. In the Yellow Sea, Bohai Sea, East China Sea and South

China Sea, 21 profiles were established. SOA carries out monitoring twice a year. The parameters include hydrometeorology and chemistry. SOA also organized more than 60 voluntary ships to carry out observations.

In order to promote the development of the GOOS program, a delayed mode data base and real time mode data base have been set up, respectively in the National Marine Data and Information Center in Tianjin and the National Marine Forecasting Center in Beijing with the input of data from coastal stations and buoys. Any member state can access these data by Internet. China will make continuous efforts to improve high-tech research in the field of the ocean observation and make contributions to the implementation of the GOOS program.

Indonesia
by Jan Sopaheluwakan

Not available at the time of production of the report

Malaysia
by Fredolin T. Tangang

With its long coastline, Malaysia is essentially a maritime nation. It is basically bounded by the Andaman Sea and the Strait of Malacca in the west, the Sulu and Sulawesi Seas in the east and the South China separating the Malay Peninsula from the eastern Malaysian enclaves of Sabah and Sarawk on the northern part of the island of Borneo. These regional seas are shared by various neighboring nations. Also, as it is located in a region of rising branches of two Walker circulations over the Indian Ocean and the Pacific Ocean, its climate and weather variability is very much influenced by the remote forcing exerted by the conditions in the Indian and Pacific Oceans.

The needs for *oceanographic information are as follows:*

- For the purpose of effective resource management in its coastal marine environments and the EEZ, there is a clear need for sufficient hydrographic and oceanographic information.
- Disaster mitigation.
- Weather/Climate forecasting.

Agencies involved in marine / oceanographic activities:

There are various government and private agencies involved in marine and oceanographic related activities, among which:

Government agencies:

- Universities.
- Royal Malaysian Navy.
- Malaysian Meteorological Services.
- Other Agencies (e.g. Marine Dept, Geological Dept.).

Private agencies:

- Petronas, Shell.

Type of Activities:

There are various activities undertaken by these agencies. These may be summarized as follows:

- Hydrographic surveying in EEZ (mainly by RMN).
- Coastal physical processes (mainly by researchers in universities).
- Marine Ecosystem Study (mainly by researchers in universities).
- Weather/Climate variability (MMS & universities).
- Large-scale surveys (South China Sea, universities in collaboration with other nations, e.g Japan).

Establishment of RMNODC, NORCC, and NOD:

In 1994 the Royal Malaysian Navy Oceanographic Data Center was established to facilitate data sharing and exchanges among various agencies in Malaysia. In 1995, the first National Oceanographic Coordination Committee Meeting (NORCC) was established. The prime role of this committee is to coordinate various oceanographic related activities including oceanographic cruises, data collection, data exchanges and data archiving among all agencies involved. Another significant development achieved under this committee is the establishment of the National Oceanographic Directorate (NOD), which is the National Focal Point in all aspects of oceanographic activities in the country.

SEAGOOS prospects:

Malaysia shares many seas with other neighboring nations. As such it is vital for Malaysia to foster cooperation with these nations in oceanographic and marine related activities. Malaysia greatly benefits from such an alliance.

Philippines

by Cesar Villanoy

Philippines needs for SEAGOOS

SEAGOOS is expected to provide improved ocean and weather information and data on an operational basis. This will contribute to improved ocean and meteorological forecasting and prediction systems. These types of information are critical for a maritime country like the Philippines where economic activities associated with the marine environment (marine resources, marine transport) contribute a significant proportion to the GNP. Loss to human lives and economic activities from natural disasters (e.g. typhoons, floods, storm surges) can also be minimized with improved prediction of such events. Availability of near real time information can provide valuable inputs in the development of contingency plans for disaster mitigation.

Agencies mandated to provide operational ocean observing and forecasting products to other agencies and the general public include the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) which is the weather service branch and operates under the Department of Science and Technology. PAGASA maintains the network of weather stations located in major cities and towns and operates the satellite ground stations used for weather predictions. The Philippine Institute of Volcanology and Seismology, also an Institute of the Department of Science and Technology is mandated to monitor seismic and volcanic activities, and

operates seismic prediction and warning systems. The National Mapping and Resource Information Authority is responsible for operation of the sea level monitoring network. It is also the mandated oceanographic service agency but needs to develop the capability to provide the needed oceanographic information required by the government and the private sector. The Bureau of Fisheries and Aquatic Resources is the fisheries resources regulatory body and monitors several fisheries related factors under resource management programs such as fisheries catch and fishing effort, and red tide occurrences. Pollution and the state of the coastal environments are monitored in a few key areas by the Department of Environment and Natural Resources.

Priority needs:

The perceived need that could be realized within the context of SEAGOOS is the ability to provide data information about the coastal areas and archipelagic seas at a higher spatial and temporal resolution from what is currently available. Of particular interest, particularly to the coastal scientists, resource managers, and local governments is the capability to relate regional to large-scale climate variability to local conditions to determine impacts to local systems. An initial approach would involve higher resolution models, probably linked or nested with larger scale regional models. Such improved data and information will hopefully improve forecasting skill of predictive models (e.g. storm surge, wave forecasting and rainfall prediction for flood control associated with tropical cyclones) and provide valuable information for disaster mitigation.

The development of remote sensing capabilities will also improve ability to monitor the adjacent waters. Aside from satellite altimeters, scatterometers and radiometers, ocean color remote sensing is believed to be a useful tool, particularly for fishery resource assessment and coastal habitat systems.

Achieving this will require a substantial investment in both training and technology transfer. GOOS related data are typically large consisting of a huge amount of data. Transferring this data to those who need it requires a fairly robust data communication system, which may need to be enhanced. Associated with this is the need to enhance computing as well as remote sensing capabilities. Manpower development to train young oceanographers and meteorologists in data management and remote sensing is required.

The Philippines is a natural disaster prone area making the benefits of an ocean observing system even more important. It should be noted that those who can benefit most from such a system are not the technically savvy scientists but those who are directly involved in the management of the coastal ocean. It is therefore imperative that SEAGOOS provide the data and information requirements to them in a language they can understand.

Singapore
by Liam Tian Kuay

Marine meteorological and oceanographic activities in Singapore

In Singapore, the marine meteorological and oceanographic activities are undertaken from two fronts: an operational mode and a research mode. Three main organizations are actively involved in the operational mode. These organizations are: the Meteorological Service Singapore (MSS), Ministry of Communications & IT, the Maritime Port Authority (MPA), Ministry of Communications & IT, and the Ministry of the Environment. These organizations have been vested with regulatory powers to ensure safe sea operations and to safeguard the quality of the

environment and eco-system of the country. To support their operations, these organizations maintain a range of operational networks of observational stations and systems for the monitoring of meteorological conditions, such as wind, temperature, rainfall, etc., oceanographic conditions, such as tide, currents, sea surface temperatures, water quality, etc. In addition, these organizations have developed various techniques such as using numerical models to monitor and forecast the conditions of the atmosphere and the seas for purposes such as for disaster mitigation, pollution control, safe sea operations, etc.

To better support the national operational needs, various research institutions have been established in the country to provide the research and development support. These research institutions include the Tropical Marine Science Institute (TMSI), the Center for Biological Science at the National University of Singapore and the Center for Remote, Imaging, Sensing and Processing Center (CRISP). For both TMSI and CRISP research and development effort is focused on specific user applications. These institutions are well equipped with the facilities and manpower resources to undertake research and development work on oceanography, particularly relating to the coastal waters surrounding Singapore. Advanced ocean, biological, chemical and dispersion modeling and studies, geographic information systems and visualization research and development work are undertaken at the TMSI. CRISP develops the application of remote sensing technology in oceanography and it include the remote sensing of red tide, ocean color, currents, sea surface temperatures, etc.

Thailand
by Anond Snidvongs

Operational Oceanographic Data/Information Services in Thailand

In Thailand oceanographic operational oceanographic data services are mainly provided by:

Hydrographic Department, Royal Thai Navy, for the general public:

Data Type: Tidal Prediction
Geographic Coverage: Thailand coastal and island stations (21 in the Gulf of Thailand and 6 in Andaman Sea)
Time Scale: hourly forecast
Distribution: Hard copy, www (http://www.navy.mi.th/hydro/tide.html)

Data Type: Daily meteorological forecast
Geographic Coverage: Gulf of Thailand and eastern part of Andaman Sea
Time Scale: Daily forecast
Distribution: Radio, www (http://www.navy.mi.th/navymet/index.htm)
Data Type: Wave forecast (WAM Model)
Geographic Coverage: Southeast Asia (10S-30N and 85E-125E) and Thailand (6N-14N and 97E-105E)
Time Scale: 12-hourly forecast
Distribution: www (http://www.navy.mi.th/navymet/waveht.htm)

Data Type: Current and circulation (POM Model)
Geographic Coverage: Gulf of Thailand
Time Scale: Not known
Distribution: Offline only (under development)

Meteorological Department, Ministry of Transports and Communication. for general public

Data Type: Daily weather forecast (synoptic based)
Geographic Coverage: Gulf of Thailand, Andaman Sea, Malacca Strait, and western part of the South China Sea
Time Scale: Daily forecast
Distribution: www (http://tmd.motc.go.th/eng/index.html,

Data Type: Numerical Weather Forecast (experimental)
Geographic Coverage: Thailand (17-km) and Southeast Asia (48-km)
Time Scale: 6-hourly (3 day forecast)
Distribution: www (http://tmd.motc.go.th/nwp/index.html)

Data Type: Wave and Wind Field at 10m (WAM)
Geographic Coverage: Southeast Asia (0-25N and 90-115E)
Time Scale: 3-hourly forecast
Distribution: www (http://www.tmd.go.th/~marine/wam.htm)

Data Type: Delayed mode weather observation data
Geographic Coverage: Thailand (land and sea based stations)
Time Scale: Hourly to monthly
Distribution: Offline (http://www.tmd.motc.go.th/service.htm)

SEAWATCH Thailand, Geo-Informatic and Space Technology Development Agency, Ministry of Science, Technology and Environment, for registered users

Data Type: Surface Oceanographic Data from Buoys
Geographic Coverage: Gulf of Thailand and Andaman Sea
Time Scale: 15 minutes (delayed mode)
Distribution: Offline

Vietnam
By Bui Dinh Khuoc

History of marine investigation activities in Vietnam

1930: Establishment of the Institute of Oceanography in Nha Trang.
1930-1945: Many cruises undertaken in the South China Sea: using the research steamship “De Lanessan”
1945-1954: Marine research was almost interrupted in the war times.
1954-1975:

In the North of Vietnam

- Vietnam-China Cooperative Programme of complex investigation in the Gulf of Bacbo (1959-1965)

- Vietnam-Soviet Union cooperative evaluation of the fisheries resources of Bacbo Gulf. (1960-1961)

In the South of Vietnam

- NAGA Expedition of marine investigation in the South China Sea and the Gulf of Thailand. (1959-1961)
- Trawling survey in the South China Sea and the Gulf of Thailand (1969-1971)
- Since 1975:
- National Program for Marine research (1977-2000)
- Vietnam-Soviet Union Cooperative Program of evaluation of the fisheries resources of the Vietnam Sea (1979-1984).
- Vietnam-Russian Cooperative Program of Study on the meteo-hydrological characteristics of the Vietnam continental shelf (1992-1995).
- Project of cooperative study on the Gulf of Thailand (1999).
- Joint oceanographic research Expedition Vietnam-Philippines in the South China Sea (1996-2000).

Oceanographic data national sources in Vietnam

Long term series data provided by regular coastal and island marine meteo-hydrological station.

- 17 coastal and island marine meteo-hydrological station, established since 20-60 years ago.
- Buoys and tide gauge network, in operation in coastal and offshore waters since 1995.
- 15 Monitoring station distributed along the coast of Vietnam for seasonal observations on marine environment factors.

Oceanographic cruise data:

- 1982-1984: 9 cruises realized by the I.O. of Vietnam(in Nha Trang) and the Institute of Marine Biology, Institute of Oceanology, Vladivostok, Soviet Union in the southern part of the Vietnam Sea.
- 1979-1984: 16 cruises in the Vietnam sea area from Bacbo Gulf to the Gulf of Thailand in the cooperation of the institutes of Fisheries of Vietnam and Soviet Union.
- 1992-1995: 11 cruises in the whole area of the continental shelf of Vietnam, undertaken with the cooperation of General Direction of Meteorology and Hydrology of Vietnam and the State Committee for Meteorology and Hydrology of Soviet Union.
- 1996-2000: 2 cruises of the Vietnam-Philippines Joint Oceanographic and Marine Scientific Research Expedition in the South China Sea.
- 1999-2001: regular cruises (2cruises/year) in the Vietnam sea area carried out by the I.O. and other institution in Vietnam.
- 1994-1999: 3 cruises in the eastern part of the Gulf of Thailand(in the framework of the National Program for Marine Research activities).
- 1999: 1 cruises across the mouth of the Gulf of Thailand in the WESTPAC Program of cooperative study on the Gulf of Thailand (from Ca Mau (Vietnam) to Malaysia).
- 1998:2 cruises of the Vietnam-Thailand joint survey on Fisheries resources and oceanography in the Gulf of Thailand, using Bien Dong and Chulalongkorn research vessels.

Present status of oceanographic data management in Vietnam

Vietnam has an oceanographic data archive, which was effectively utilized in the economic development of the country. However, because of the long war time and other reasons, the oceanographic data archive in Vietnam at present time is no longer considered well managed. The oceanographic data are now extremely dispersed over different oceanographic research institutions in the country. The country has not yet defined a national oceanographic data exchange policy. A National Organization of Oceanographic data management is still in the stages of preparation. International oceanographic data exchange of Vietnam is still not developed. This points to the urgent need for:

- a national policy on the oceanographic data exchange,
- the establishment of a National oceanographic database with a management at the national level,
- sufficiently qualified special staff and necessary capacity building
- a developed international exchange relationship is now an urgent need in Vietnam.

ANNEX III

LIST OF PARTICIPANTS

AUSTRALIA

Dr. Angus McEwan
Bureau of Meteorology
GPO Box 727, Hobart
Tasmania 7001
AUSTRALIA
Tel: +61 3 6221 2090
Fax: +61 3 6221 2089
E-mail:mcewan@bom.gov.au

Dr. Susanne Wijffels
CSIRO Marine Research
Castray Esplanade, Hobart
TAS 7000
AUSTRALIA
Tel: +61 3 6232 5450
Fax: +61 3 6232 5123
E-mail:susan.wijffels@marine.csiro.au

INDONESIA

Dr. Jan Sopaheluwakan
Deputy Chairman for Earth Sciences
Indonesian Institute of Sciences (LIPI)
Sasana Wydia Sarwono
Jl. Gatot Subroto 10
Jakarta 12710
INDONESIA
Tel: +62 21 526 0804
Fax: +62 21 526 2824
E-mail: jans@mss.lipi.go.id

Ms. Melati F. Fachrul
Environmental Engineering
FALTL-Universitas Trisakti-Jakarta
Jl. Kyai Tapa No.1 (Grogol)
Jakarta, DKI Jakarta
11440
INDONESIA
Tel: +62 21 526 2824
E-mail: melatif@hotmail.com

Dr. Zainal Arifin
Research and Development Center for Oceanology
Jl. Pasir Putih No.1,
Jakarta 14430
INDONESIA
Tel: +62 21 683850
Fax: +62 21 681948
E-mail: zarifin@dnet.net.id

JAPAN

Dr. Hiroshi Kawamura
Center for Atmospheric and Oceanic Studies
Graduated School of Science, Tohoku University
Aramaki-Aza-Aoba
Aoba-Ku, Sendai
Miyagi 980-8578
JAPAN
Tel: +81 22 217 6745
Fax: +81 22 217 6748
E-mail: kamu@ocean.caos.tohoku.ac.jp

Dr. Douglas W. Edsall
Associate Director, ONRIFO ASIA
7 -23-17 Roppongi
Minato-ku
Tokyo 106-0032
JAPAN
Tel: +81 3 3401 8924
Fax: +81 3 3403 9670
E-mail:edsalld@onrasia.navy.mil

Prof. Keisuke Taira
Physical Oceanography
Ocean Res. Inst., University of Tokyo
Minamidai 1-15-1, Nakano
Tokyo 164-8639
JAPAN
Tel: +81 3 5351 6417
Fax: +81 3 5351 6418
E-mail:taira@ori.u-tokyo.ac.jp

Mr. Naoyuki Hasegawa
Climate Prediction Division
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku
Tokyo 100-8122
JAPAN
Tel: +81 3 3212 8341 - ext. 5135
Fax: (81 3 3211 3047
E-mail:n-hasegawa@met.kishou.go.jp

MALAYSIA

Dr. Fredolin T. Tangang
Marine Science Program, School of
Environmental & Natural Resource Sciences
Faculty of Science & Technology
National University of Malaysia, Bangi
Nabgi, Selangor 43600
MALAYSIA
Tel: +60 3 8429 3343
Fax: +60 3 8725 3357
E-mail:tangang@pkrisc.cc.ukm.my

Prof. Mohamad Nor Said
Center for Geographic Information
& Analysis
Universiti Teknologi Malaysia
UTM Skudai
Johor Baharu 81310
MALAYSIA
Tel: + 60 7 550 2964
Fax: + 60 7 556 6163
E-mail: m.nor@fksg.utm.my

Ms. Sharifah N. Syed-Ibrahim
School of Biological Sciences
Universiti Sains Malaysia
11800 Minden
Penang 11800
MALAYSIA
Tel: +604 657 7888 ext 3524
Fax: +604 656 5125
E-mail: noraibrahim@yahoo.com
nora@usm.my

First Admiral Mohd Rasip bin Hassan
Royal Malaysian Navy
Markas Pendidikan dan Latihan TLDM
Pangkalan TLDM, Lumut
Perak Darul Ridzuan
32100
MALAYSIA
Tel: +605 680 2504
Fax: +605 683 4007
E-mail: rmnodc@tm.net

NORWAY

Dr. Johannes Guddal
Norwegian Meteorological Institute
Region West
Allegaten 70
Bergen 5007
NORWAY
Tel: 47 5523 6626
Fax: 47 5523 6703
E-mail: j.guddal@dnmi.no

PEOPLE'S REPUBLIC OF CHINA

Mr. Zhu Wenxi
Department of International Cooperation
State Oceanic Administration
1 Fuxingmenwai Ave.
Beijing 100860
CHINA
Tel: +86 10 6804 2695
Fax: +86 10 6803 9791
E-mail:soadio@public.east.net.cn

Mr. Qu Qiang
Department of Marine Environmental
Protection
State Oceanic Administration
1 Fuxingmenwai Ave.
Beijing 100860
CHINA
Tel: +86 10 6804 2695
Fax: +86 10 6803 9791
E-mail:soadio@public.east.net.cn

PHILIPPINES

Mr. Rolando S. Balotro
Department of Meteorology and
Oceanography
University of the Philippines
NIGS Building, U.P. Diliman
Quezon City
Metro Manila 1101
PHILIPPINES
E-mail:balotro@esst.kyushu-u.ac.jp
rsbalotro@hotmail.com

Dr. Cesar L. Villanoy
Marine Science Institute
University of the Philippines
Diliman
Quezon City 1101
PHILIPPINES
Tel: +63 2 922 3944
Fax: +63 2 924 7678
E-mail: cesarv@upmsi.ph

Dr. Miguel D. Fortes
Marine Science Institute
College of Science
University of the Philippines
Diliman, Quezon 1101
PHILIPPINES
Tel: +63 2 922 3959
Fax: +63 2 924 7678
E-mail: fortesm@upmsi.ph
mdfortes@pacific.net.ph

SINGAPORE

Dr. Lim Tian Kuay
Meteorological Service Singapore
Ministry of Communications
P.O.Box 8
Changi Airport
Singapore 918141
SINGAPORE
Tel: + 65 545 7195
Fax: + 65 545 7192
E-mail: Lim_Tian_kuay@mss.gov.sg

THAILAND

Dr. Anond Snidvongs
Southeast Asian STRAT Regional Centre
Chulalongkorn University
5th Floor, SWU Building No. 5
Henri Dunant Rd., Patumwan, Bangkok
10330
THAILAND
Tel: +66 2 2189464
Fax: +66 2 2519416
E-mail: anond@start.or.th

Prof. Manuwadi Hungspreugs
Department of Marine Science
Faculty of Science, Chulalongkorn University
Phayathai Rd, Bangkok 10330
THAILAND
Tel: +66 2 2185409
Fax: +66 2 2550780
E-mail:Manuwadi.H@Chula.ac.th

Dr. Gullaya Wattayakorn
Department of Marine Science
Chulalongkorn University
Phayathai Road, Bangkok 10330
THAILAND
Tel: +66 2 2185409
Fax: +66 2 2550780
E-mail: gullaya@chula.ac.th

Ms. Watanee Saransuth
IOC/WESTPAC
196 Phaholyothin Rd.
Chatujak
Bangkok 10900
THAILAND
Tel: +66 2 5615119
Fax: +66 2 5615119
E-mail: swatanee@loxinfo.co.th

UNITED STATES

Dr. R. Dwi Susanto
Oceanography, Lamont Doherty Earth
Observatory of Columbia University
205 Oceanography, 61 Route 9 W
Palisades, New York
10964-8000
USA
Tel: +1 845 365 8545
Fax: +1 845 365 8157
E-mail: dwi@ldeo.columbia.edu

Dr. Reginald Beach
Ocean, Atmosphere and Space
US Office of Naval Research
223 Old Marylebone Rd.
London, NWI 5TH
UNITED KINGDOM
Tel: +44 207 514 4964
Fax: +44 207 723 4359
E-mail: rbeach@onrifo.navy.mil

VIETNAM

Mr. Bui Dinh Khuoc
Marine Hydrometeorological Center
Nguyen Chi Thanh
Hanoi
VIETNAM
Tel: +84 4 773 0729
Fax: +84 4 835 0606
E-mail: mhcdanv@hn.vnn.vn

Dr. Nguyen Manh Hung
Institute of Marine Mechanics
264 Doican
Hanoi
VIETNAM
Tel: +84 4 832 6382
Fax: +84 4 832 7924
E-mail: nmhung@im01.ac.vn

Prof. Dang Ngoc Thanh
National Center for Natural Science and
Technology
Hoang Quoc Viet Road.
Hanoi
VIETNAM
Tel: +84 4 836 1778
Fax: +84 4 756 4483
E-mail: dnthanh@ncst.ac.vn

Prof. Dinh Van Uu
Head Department of Oceanography
Marine Dynamics and Environment Research
Center, Hanoi University of Sciences
334 Vguyen Trai, Thanh Xuan
Hanoi
VIETNAM
Tel: +84 4 858 4945
Fax: +84 4 858 4945
Email: ocean@hn.vnn.vn
uudv@vnu.edu.vn

IOC SECRETARIAT

Dr. William Erb
Head, Intergovernmental Oceanographic
Commission, Perth Regional Programme
Office c/o Bureau of Meteorology
P.O.Box 1370, West Perth
WA 6872
AUSTRALIA
Tel: +61 8 9226 2899
Fax: +61 8 9226 0599
E-mail: w.erb@bom.gov.au

ANNEX IV

WORKSHOP STEERING COMMITTEE

Angus McEwan	mcewan@bom.gov.au
Johannes Guddal	j.guddal@dnmi.no
Reginald Beach	rbeach@ornifo.navy.mil
Anond Snidvongs	anond@start.or.th
Susan Wijffels	susan.wijffels@marine.csiro.au
Fadm. Mohd Rasip bin Hassan	rmnodc@tm.net
Lim Tian Kuay	Lim_Tian_kuay@mss.gov.sg
Naoyuki Hasegawa	n-hasegawa@met.kishou.go.jp
Maarten Kuijper	westpac@samart.co.th
William Erb (Chairman)	w.erb@bom.gov.au

ANNEX V

LIST OF ACRONYMS

APEC	Asia-Pacific Economic Cooperation
ARLINDO	Arus Lintas Indonesia (joint US-Indonesian Research Program)
ASCMG	ASEAN Sub-Committee on Meteorology and Geophysics
ASEAN	Association of South East Asian Nations
ASMC	ASEAN Specialized Meteorological Center (Singapore)
BOM	Bureau of Meteorology (Australia)
CCOP	Coordinating Committee for Geoscience Programmes in East and Southeast Asia
C-GOOS	Coastal GOOS
COOP	Coastal Ocean Observations Panel
COST	ASEAN Committee on Science and Technology
CRISP	Center for Remote, Imaging, Sensing and Processing Center (Singapore)
CTD	Conductivity, Temperature, Depth (instrument)
EEZ	Exclusive Economic Zone
GEF	Global Environmental Facility
GIS	Geographic Information System
GODAE	Global Ocean Data Assimilation Experiment
GOOS	Global Ocean Observing System
GOT	Gulf of Thailand
GPS	Global Positioning System
GRA	GOOS-Regional Alliance
GTS	Global Telecommunication System
HF	High Frequency
ICM	Integrated Coastal Management
ICRI	International Coral Reef Initiative
ICZM	Integrated Coastal Zone Management
IOC	Intergovernmental Oceanographic Commission
IOCARIBE	IOC Sub-Commission for the Caribbean and Adjacent Regions
IODE	International Oceanographic Data and Information Exchange
IRI	International Research Institute for Climate Prediction
ITF	Indonesian Throughflow
JADE	Java Australia Dynamics Experiment
JCOMM	Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
JMA	Japan Meteorological Agency
JOMSRE	Joint Oceanographic and Marine Research Expedition (Philippines - Vietnam)
JSPS	Japan Society for the Promotion of Science
KORDI	Korea Ocean Research and Development Institute
Med-GOOS	Mediterranean GOOS
MMS	Malaysian Meteorological Service
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MPA	Maritime Port Authority (Singapore)
MSI	Marine Science Institute, University of the Philippine
MSS	Meteorological Service Singapore
NASA	National Aeronautics and Space Administration
NEAR-GOOS	North East Asian Region GOOS

NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration (USA)
NOD	National Oceanographic Directorate (Malaysia)
NORCC	National Oceanographic Coordination Committee Meeting (Malaysia)
OOPC	Ocean Observing Panel for Climate
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
PORSEC	Pacific Ocean Remote Sensing Conference
QA/QC	Quality Assurance/Quality Control
RMN	Royal Malaysian Navy
RMNODC	Royal Malaysian Navy Oceanographic Data Center
R/V	Research Vessel
SCS	South China Sea
SEACAMP	South East Asian Centre for Atmospheric and Marine Prediction
SEAGOOS	South East Asian Global Ocean Observing System
SEA START RC	Southeast Asian START Global Change Regional Center
SeaWiFS	Sea-Viewing, Wide Field-of-view Sensor
SOA	State Oceanic Administration (China)
TCP	Tropical Cyclone Program
TMSI	Tropical Marine Science Institute (Singapore)
TOGA	Tropical Ocean and Global Atmosphere Program
UN	United Nations
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific Cultural Organization
UV	Ultraviolet Radiation
VOS	Voluntary Observing Ships
WESTPAC	IOC Sub-Commission for the Western Pacific
WMO	World Meteorological Organization of the United Nations
WOCE	World Ocean Circulation Experiment
XBT	Expendable Bathythermograph (instrument)
XCTD	Expendable Conductivity-Temperature-Depth (instrument)

In this Series, entitled

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

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

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

121. IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional Global Ocean Observing System (NEAR-GOOS), Second Session, Thailand, 1997

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

156. First Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Venezuela, 1999 ***(also printed in Spanish and French)***

157. Fourth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), China, 1999

158. Eighth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Russian Federation, 1999

159. Third Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), Chile, 1999

160. Fourth Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS). Hawaii, 2000

161. Eighth Session of the IODE Group of Experts on Technical Aspects of Data Exchange, USA, 2000

162. Third Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 2000

163. Fifth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Poland, 2000

164. Third Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 2000

165. Second Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Cuba, 2000 ***(also printed in Spanish and French)***

166. First Session of the Coastal Ocean Observations Panel, Costa Rica, 2000

167. First GOOS Users' Forum, 2000

168. Seventh Session of the Group of Experts on the Global Sea Level Observing System, Honolulu, 2001

169. First Session of the Advisory Body of Experts on the Law of the Sea (ABE-LOS), France, 2001 ***(also printed in French)***

170. Fourth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, Chile, 2001

171. First Session of the IOC-SCOR Ocean CO_2 Advisory Panel, France, 2000

172. *Cancelled*

173. Third Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, USA, 2001 ***(also printed in Spanish and French)***

174. Second Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Italy, 2001

175. Second Session of the Black Sea GOOS Workshop, Georgia, 2001

176. Fifth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2000

177. Second Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Morocco, 2002 ***(also printed in French)***

178. Third Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Vietnam, 2002

179. Fourth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), France, 2002

180. Second Session of the IOC-SCOR Ocean CO_2 Advisory Panel, Honolulu, Hawaii, U.S.A, 9 February 2002 ***(electronic copy only)***

181. IOC Workshop on the Establishment of SEAGOOS in the Wider Southeast Asian Region, Seoul, Republic of Korea, 30-31 August 2001 (SEAGOOS preparatory workshop) ***(electronic copy only)***