Intergovernmental Oceanographic Commission

Workshop Report No. 116

IOC/WESTPAC International Scientific Symposium on Sustainability of Marine Environment: Review of the WESTPAC Programme, with Particular Reference to ICAM

Bali, Indonesia
22-26 November 1994

UNESCO

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1. INTRODUCTION

Following the decision at its First Session that a major multidisciplinary symposium should become a principal intersessional activity of the Sub-Commission, the IOC Sub-Commission for the Western Pacific (WESTPAC) proposed, at its Second Session (Bangkok, Thailand, 25-29 January 1993), through Recommendation SC-WESTPAC-II.1, that a major international IOC/WESTPAC Marine Science Symposium be organized in 1994 or 1995, in view of the success of the first and second symposia. The IOC Assembly at its Seventh Session (Paris, 25 February - 11 March 1993) approved the recommendation through Resolution XVII-12 stressing that the symposium should be a key element of the WESTPAC activity over the following intersessional period.

To ensure an effective organization of the Symposium, the Second Session of the Sub-Commission decided to establish a Scientific Organizing Committee and a Local Organizing Committee, and agreed on the structure, time table and topics of the Symposium.

With the kind offer of the Government of Indonesia to host the Symposium and financial support from various Member States, the Symposium was held in Bali, Indonesia, 22-26 November 1994. More than 200 scientists from 28 countries from inside and outside the WESTPAC region participated in the Symposium. Some 124 scientific papers were presented at the plenary and parallel sessions. The programme of the Symposium is attached as Annex I. The list of participants is shown in Annex V.

2. OPENING

The opening ceremony began at 0900 hours on 22 November 1994 in the Sahid Bali Seaside Hotel, Bali, Indonesia.

The Chairman of the Local Organizing Committee, Dr. Anugerah Nontji, first reported to the participants on the preparation of the Symposium. He expressed his appreciation to all Member States and scientists for their contributions to make the Symposium a reality. He then invited His Excellency Governor of Bali, Prof. Ida Bagus Oka, to deliver a speech. Prof. Oka welcomed all the participants and IOC/WESTPAC officers to this important Symposium in Bali. The Governor underlined the important role of the ocean to the development of national economy by citing the case of Bali as an island. He wished the meeting a full success and all participants an enjoyable stay in Bali.

Prof. Su Jilan, Chairman of IOC/WESTPAC, expressed his sincere gratitude to the Government of Indonesia for hosting the Symposium. He thanked all members of the Scientific Organizing Committee, chaired by Prof. Tomio Asai and the Local Organizing Committee chaired by Dr. A. Nontji for their effective and hard work in the preparation of the Symposium. He also thanked the donor countries for their financial support to the Symposium. The Chairman informed the Symposium that WESTPAC programmes and projects will also be reviewed during the Symposium and future activities will be identified for the implementation of the programmes of the Sub-Commission.

Dr. Gunnar Kullenberg, Secretary IOC first paid tribute to the Local Organizing Committee for their excellent arrangement and preparation for the Symposium, especially Dr. A. Nontji, and Prof. Aprilani Soegiarto, Vice-Chairman of the Indonesian Institute of Sciences (LIPI).

By reviewing the history of marine related sciences in the region, in particular the observation in Batavia, now Jakarta, started in 1866, the Secretary IOC stressed the importance of long-term co-operation with Member States and the organizations concerned to promote marine sciences, systematic observations, and ocean services. He also emphasized the great importance of the presence of a mechanism acting as the intergovernmental platform for marine science and as a full partner in various international negotiations, policy formulations and implementations.

The Secretary concluded his address by thanking all those who have contributed to the Symposium, and in particular those who had provided financial support through the mechanism of the IOC Trust Funds, namely, Australia, the Netherlands, Japan and USA.

On behalf of Prof. Samaun Samadikun, the Chairman of Indonesian Institute of Sciences (LIPI), Dr. Aprilani Soegiarto, the Vice-Chairman of LIPI, welcomed all participants to Bali, Indonesia attending the Symposium. Referring the ENSO study in Indonesia, he stressed the importance of long-term systematic observation in marine scientific research and ocean-related activities. He briefly introduced the historical variation of coastline in Bali over history, and called for more efforts on integrated coastal zone management by scientists and policy makers.

Finally, His Excellency Minister of Education and Culture of Indonesia, Prof. Dr. Wardiman Djojonegoro, joined the previous speakers in welcoming all participants to the Symposium and stressed the importance of sustainable use of marine resources and the protection of marine environment, especially in the coastal areas.

The Minister further indicated that the scientific knowledge can only be useful and valuable when applied for certain purpose. He took integrated coastal zone management as an example and urged scientific community to consider seriously the application of their scientific research to the integrated coastal zone management. His speech is given in Annex III.

His Excellency the Minister officially opened the Symposium.

3. SCIENTIFIC PRESENTATION

Scientific presentations were made in plenary and parallel sessions, focusing on biogeochemical processes and their impact on regional biodiversity; dynamics, modeling and prediction of transport phenomena; climate variability - predictivity and impact, and integrated coastal area management. On day 1, the following keynote speeches were presented in the plenary:

(i) An Integrated Scientific Approach to Coastal Areas Management, Dr. Don Young Lee, Korean Ocean Research and Development Institute, Korea.

(ii) Biogeochemical Processes and their Impacts on Regional Biodiversity, Prof. Dr. Chou Loke Ming, National University of Singapore.

(iii) Dynamics, Modelling and Prediction of Transport Phenomena, Dr. Tetsuo Yanagi, Ehime University, Japan.

(iv) Climate Variability: Predictability and Impacts on the coastal Areas, Dr. J. Stuart Godfrey, CSIRO, Division of Oceanography, Australia.

(v) The Scientific Rational for Biodiversity Maintenance, Prof. Brian J. Rothschild, University of Maryland, USA.

(vi) Integrated Coastal Management and its Socio-economic Issues, Prof. A.C. Alcala, Philippines.

The parallel sessions started on Day 2 through Day 3, addressing the following topics:

(i) Biogeochemical processes and its impacts on regional bidodiversity: Harmful algal blooms, river input of pollutants, impacts on mangrove, seagrass and coral reef;

(ii) Dynamics, modelling and prediction of transport phenomena: Nearshore currents and sediment transport, continental circulation, tide and tidal phenomena, storm surges and tsunamis;

(iii) Climate variability, predictability and impacts: Long-term records, ENSO and the seal level signal, climate change impacts on the coastal zone and biodiversity.

On day 4 a plenary session on Integrated Management of Coastal Areas : The Role of Marine Science and Systematic Observations was held with presentations on :

(i) IOC - COASTS

(ii) The Importance of the Regions in the Concept of GOOS

(ii) Scientific Approaches to Integrated Coastal Zone Management

(iv) A Manager's View of Integrated Coastal Zone Management

(v) Human Resources Development in Coastal Resources Management

(vi) Main Resources Evaluation and Planing in Indonesia

(vii) Developing Data and Information Systems for Integrated Coastal Zone Management.

The presentations also covered a wide range of topics in relation to the integrated coastal zone management from the views of scientists and managers, with emphasis on what scientific information from on-going and planned programmes can contribute to ICZM and how management requirements should be met for the ICZM.

A panel discussion on ICZM followed with its focus on how the scientists and managers could work together in an integrated way to achieve the purpose of sustainable use of coastal resources. Further studies on this issue were required for a better understanding on sustainable development and integration of efforts in coastal areas.

It was obvious from the scientific presentations that young scientists in various countries of the region are playing an increasingly active role in marine scientific research and monitoring programmes, both at national and international. Many interesting scientific results showed that IOC/WESTPAC projects have provided useful and effective infrastructure for the national, regional and international co-operation on marine science and service programmes/projects.

The abstracts of scientific papers presented to the Symposium are attached as Annex II.

4. REVIEW OF THE IMPLEMENTATION OF THE IOC/WESTPAC PROGRAMMES

The implementation of IOC/WESTPAC programmes/projects were reviewed by several groups of scientists, in the pre-workshops and group discussions during the Symposium. The workplans for 1995/1996 of various groups are summarized below.

4.1 OCEAN DYNAMICS AND CLIMATE (ODC)

The meeting reviewed the status of implementation of the programme, and proposed future activities in a project by project fashion.

4.1.1 Banding of Porites Coral as a Component of Ocean Climate Study

The participants indicated that certain massive corals contain annual density banding patterns analogous to tree rings. The high-resolution proxy climate records will make a major contribution to the understanding of past climate variations, and will also provide a means to monitor the coral reef environments. Such information is definitely necessary to assess the impacts of anthropogenic changes to reef environments and, can be an important tool in reef management strategies.

Though much effort has been made at the Australian Institute of Marine Sciences (AIMS), knowledge has not advanced sufficiently in order than the procedures and techniques can be readily taught. It is suggested that scientists from other WESTPAC Member States should work with the AIMS Coral Banding Group (led by D.J. Barnes and J.M. Lough). Financial support are requested for the education of researchers at postgraduate or post-doctoral level.

4.1.2 Ocean Dynamics in WESTPAC Region

Regarding the development of WESTPAC regional ocean modeling capability for support of resources management, there has been progress in developing models for using in the WESTPAC region. The progress is linked with observational efforts under international, multi-national, bilateral programmes, such as TOGA/COARE, WOCE, ARLINDO, JADE, CREAMS, etc. However, more involvement of scientists from the WESTPAC countries should be encouraged in this field.

Several institutions of the WESTPAC countries are now developing coupled models, with some efforts attempting at prediction. It seems, however, still premature to use those climate predictions for regional practical purposes. Since the need to address climate-related stresses on the WESTPAC nations is rapidly increasing, it is most necessary to accelerate the development of coupled ocean-atmosphere-land models, in association with the effort to implement a long- term observing system which will provide assimilation data for those models.

Regarding the involvement of WESTPAC scientists in planning of the regional aspects of future global programmes, a new climate research programme named CLIVAR/GOALS is evolving. Each ocean basin has its unique ocean climate and the WESTPAC region is located at the intersection of Pacific and the Indian Oceans. Since the understanding of so many interesting phenomena is related to the Asian monsoon, the Indian monsoon and ENSO in the region, it was suggested that scientists may contribute to the programme by planning regional aspects of CLIVER/GOALS in a more active way.

A Special Session of Western Boundary Currents was organized during the Symposium. Based on the active discussions, the meeting recognized that the monsoon-related ocean dynamics and thermodynamics are crucial for the development and improvement of ocean models, which are needed for assessments, designation of ocean observing systems and application related to coastal management issues. It will be also useful for coupled models of atmosphere and land, to better understand and hopefully predict variations of the monsoon and their associated rainfall. Therefore the participants recommended that the interactions, via oceanic and atmosphere pathways, between the Eastern Indian Ocean and the Western Pacific Ocean should be observed and studied. In particular, the mechanism of seasonal to interregnal signals of the Australia-Asian monsoon systems should be understood. For the above purpose, coordination of the national and international programmes in the WESTPAC region concerned with the monsoon-driven circulations, their variations and impacts should be fostered by IOC/WESTPAC. This includes such efforts in the programmes as CLIVAR/GOALS and the GEWEX Asian Monsoon Experiment.

For the purpose of developing linkage between western boundary current studies and marginal seas/continental shelf studies, an active Circulation Research of the Est Asian Marginal Seas (CREAMS) programme among China, Japan, Korea, and Russia has been created with financial support from the Ministry of Education, Science and Culture of Japan. The objective of the programme is to understand wind-driven and thermohaline circulations in the Sea of Japan and the East China Sea, which have a close linkage with the Kuroshio. The CREAMS Newsletter is available from Prof. J.H. Yoon and/or A.G.Ostrovskii (both at RIAM/Kyushu University, Japan). It would be necessary to have a similar programme in the South China Sea where is affected strongly by monsoon wind reversals.

4.1.3 Continental Shelf Circulation

The Joint Seminar of River Input/Harmful Algal Blooms/ Shelf Circulation (RI/HAB/SC) was held from 20-21 November 1994, prior to the Third WESTPAC Scientific Symposium. The project group reviewed the implementation of the project, in particular the training workshop on numerical modeling for coastal circulation organized in Ehime University, Japan from 27 September - 1 October 1993, with support from the Ministry of Education, Science and Culture of Japan. A computer programme used in the training course was made available to the participants.

The meeting also noted that the joint China-Philippines cruise in the Sula Sea was originally planned, but unfortunately cancelled due to various constrains.

The project group recognized the importance of the activity which is closely related to ODC-2, i.e. the development of NEAR-GOOS (North-East Asian Regional GOOS). An expert consultation in Beijing, China, 16-18 August 1994 and a workshop in Bali, Indonesia, 16-21 November 1994 were organized. NEAR-GOOS aims to build a regional GOOS, based largely on existing monitoring systems in the Sea of Japan, the Yellow Sea and the East China Sea with a view to exchanging data and some products in real-time or near real-time. The meeting proposed to endorse the NEAR-GOOS as a project of WESTPAC.

A training workshop on oceanographic model output visualization was also proposed to be organized in the near future.

The ODC programme group recognized that for the ocean dynamics and climate studies, the interactions among the above-mentioned projects should be strengthened. For example, due to the special effects of the Pacific and Indian Ocean through flow, the co-ordinated activity between ODC-2 and ODC-3 in the Indonesian seas will be most necessary.

4.2 MARINE POLLUTION RESEARCH AND MONITORING (MPRM)

4.2.1 Assessment of River Inputs of Pollutants to the Marine Environment

After having reviewed the implementation of the project, the meeting proposed future activities as follows:

(i) Further nutrient intercalibration exercises (low-level concentration) using the Australian samples to be purchased in March 1995 should be carried out, using a manual to be proposed by experts on nutrient analysis. Funds needed for the exercise is limited, and will be covered by either the interested laboratories or IOC/WESTPAC (US $ 100 per laboratory).

(ii) For the study of nutrient flux through the estuarine area to the coastal seas, it seems that the advices of physical oceanographers in each individual river are needed.

(iii) A network of laboratories interested in the River Input Project will be established within WESTPAC region.

(iv) In-country intercalibration exercises will be attempted to improve the experience of the laboratories with assistance of experts from other institutes.

4.2.2 Monitoring Heavy Metals and Pesticides Using the Mussel Watch Approach

The Asia-Pacific International Mussel Watch Implementation Plan was proposed by the IOC/UNU/UNEP International Mussel Watch (IMW) Workshop, Bali, Indonesia, 18-21 November 1994.

The MPRM group of WESTPAC reviewed the plan and suggested the following modification to the proposed plan.

(i) It should be stated clearly when and how the developing countries in the region would benefit from this Project. The relevant actions on "capacity-building" including intensive training (in some cases where expertise is not available in the country) in chemical analysis of the samples, up-grading the capability of the regional laboratories, should be organized in the first phase of the Implementation Plan.

(ii) Despite the fact that the project is of a monitoring nature, there is still a strong regional need to proceed with the heavy metal analysis in the laboratories within the region.

(iii) Standard reference materials and mussels should be made fully available to at least 2 laboratories in each country as soon as possible, in order that local scientists gain experiences in the analysis before the real sampling phase gets started. The local scientists should be able to take part in the analysis of collected samples as much as possible.

(iv) Further training is required, and should be organized at an appropriate time.

4.2.3 Assessment of Atmospheric Inputs of Pollutants to the Marine Environment

Prior to the Symposium, a Workshop on Assessment of Atmospheric Inputs of Pollutants took place from 20-21 November 1994. The main purposes were to review the proposed Action Plan for the project and to discuss the intercalibration procedures. The group suggested selective studies on the local and regional problems affecting the transport of atmospheric materials in the western Pacific. It was suggested that:

(i) Intercalibration for dissolved species including NO_3^-, Cl^-, SO_4^{-2} and NH_4 ions, etc. will be prepared by Dr. D.S. Lee of Yonsei University, using natural rain water.

(ii) Intercalibration for aerosol sample including heavy metals, (Fe, Al, Pb, Cd, Zu, Sc, etc.) and Na, Ca, As, and Se, etc. will be carried out, and samples will be prepared by Dr. M Uenatsu of Hokkaido University (Japan). The exercise will take place in 1995 under an estimated cost of around US$ 2,000.

(iii) A joint study on long-distance transport of dust and local pollution influences on the northwest Pacific coastal seas will be done in April-May 1995 with initial participation of 7 laboratories in China, Japan and R.Korea.

Aiming at an inter-laboratories co-operation, an exchange of scientists programme is planned and the Ocean University of Qingdao, China could provide some funds to support the implementation (2 persons, 10 days/year).

4.3 OCEAN SCIENCE IN RELATION TO LIVING RESOURCES (OSLR)

The Programme Co-ordinator, Dr. P.C. Rothlisberg, submitted a written report to the Symposium on the status of regional programme on OSLR, which is attached as Annex IV.

With regard to the Co-ordinator of the programme, at present the two active projects are coordinated by two Project Leaders - Dr. D. Staples for PREP and Dr. Y. Fukuyo for HAB. Dr. P. Rothlisberg, the WESTPAC-OSLR Coordinator, has indicated his intention to resign from his post as the Programme Coordinator. A new Programme Co-ordinator for WESTPAC-OSLR is required.

The participants of the review and planning meeting also strongly recommended that OSLR coordinator be appointed to the newly functioned WESTPAC office in Bangkok. Duties would include the facilitation of a regional network of OSLR in the region, the coordination with non-IOC/WESTPAC programmes in the region such as CIDA-ASEAN and APEC. This position could be a part- time one and link with other WESTPAC programmes.

4.3.1 IOC/WESTPAC Penaeid Prawn Recruitment Project (PREP)

Future plans for this project will depend on the level of funding available. The overall objective of PREP was to study the effect of climate on recruitment of the white prawn Penaeus mergiensis in the WESTPAC region by comparing these dynamics across a range of study sites, each with its own characteristic climate and fishing activity. Based on their own resources, various levels of sampling has been carried out as by the participating countries (Australia, China, Indonesia, Malaysia, Papua New Guinea, Philippines, and Thailand). Progress has been relatively slow and constrained by a lack of skills in sampling, data management and analyses.

At this phase of the project, it was felt that the appointment of a full time Technical Expert was crucial to the continuation of the project. A Technical Expert should be appointed to the Bangkok office and provided in-country on-the-job training in all aspects of sampling, data management, data analyses and report writing. Without this level of support, the objectives of the geographic comparison can not be realized due to lack of standardization of techniques and a general lack of skills in computing and interpretation of scientific data.

If funding for the position can not be obtained, the Project Leader recommended that the project be terminated and a final report produced incorporating the findings to date.

4.3.2 IOC/WESTPAC Harmful Algal Blooms (HAB)

At the Joint Seminar of the River Input/Shelf Circulation/HAB projects (Bali, Indonesia, 20-21 November 1994), a proposal was developed with a view to implementing a cooperative project linking physical/chemical processes with HAB. The objectives of such a study would be to :

(i) establish the relationship between HAB outbreaks and the physical and chemical characteristics of a range of study sites across the WESTPAC region

(ii) use this information in assisting fishery managers and public health officials to guide monitoring programmes, coastal development activities, aquaculture site selection etc.

The proposed research plan contains three elements:

(i) preliminary planning workshop to standardize the approach and methods

(ii) conduct seasonal field studies involving multiple cross-shore transects

(iii) annual workshops to report progress, examine new methods and solve problems.

An Action Plan was drawn up at the workshop with the following proposed actions:

(i) appoint a project coordinator

(ii) coordinator to contact funding agencies, disseminate details to participants

(iii) prepare country proposals, budgets

(iv) repare coordinator's proposal (local costs for workshops, expert travel costs, networking expenses)

(v) Submit formal proposal to regional funding agencies and to IOC/HAB office, which will help identify and contact donors.

4.3.3 Activities Related to GOOS

This will be form part of GOOS Health of the Ocean (HOTO) and Marine Living Resources (MLR) modules.

The review recognized the need to develop a regional network for monitoring the health of the living resources in the WESTPAC region. It was further recognized that this was a major undertaking but recommended that some standard form of monitoring be developed. It was argued that many of the living resources are being actively sampled on daily basis by a large number of fisherman and fisherwomen and in many countries in the region these data are being collated to produce annual fisheries statistics. For GOOS, it is the basic catch and effort data being collected that could form the input required to assess the state of the living resources in the region. By taking selected key species at selected sites, a comprehensive monitoring scheme could be put in place at a moderately low cost.

Although the FAO is currently collating fisheries production data for many countries, these production figures are of little use as a GOOS monitoring tool without the information on the amount of effort targeted at selected species. As a first step towards developing a GOOS living resources data base, it was recommended that a survey be conducted to describe the systems in place for the collection of fisheries data in each country. Following this, a workshop would be needed to develop a monitoring scheme and data base for GOOS.

The review also considered that a HAB monitoring network could be developed as part of the regional HAB project. In the first instance it was recognized that a standardized methodology would have to be developed and a monitoring plan decided on and implemented. It was recommended that this be a topic for a workshop to develop a HAB monitoring strategy of GOOS. The OSLR group discussed the activities which should be carried out during the period of 1995-1997 and they proposed the following actions as listed in Table 1.

Table 1. Proposed Activities of OSLR 1995-97

Activity	Timing	Total Cost	IOC Cost
WESTPAC OSLR Coordinator (Bangkok)*	1995-97	$30k/year?	$30k/year

*Cost to be shared with other WESTPAC programme

PREP

Activity	Timing	Total Cost	IOC Cost
Technical Expert to conduct in-country training and coordination	1995-97	100 k/year?	?
Workshop to collate results a the regional level*	1996	$20k	$10k
Workshop to collate results at the regional level	1997	$20k	$10k

*Not required if funding for Technical Expert not available

HAB

A. **Continuing Activities**

Activity	Timing	Total Cost	IOC Cost
Pyrodinium proceeding publication	1995	$1k	$1k
Leaflet series of HAB species	1995	$1k	$1k
Slides of plankton and events related to HAB	1995	$1	$1k
Re- publication of red tide algae monograph	1995	$8k	$8k (TEMA)
HAB verification	1995	nil	nil

B. **New Activities**

Activity	Timing	Total Cost	IOC Cost
Planning workshop to coordinate regional project	1995	$15k	$15k

GOOS

Activity	Timing	Total Cost	IOC Cost
workshop to develop long-term monitoring of HAB	1996	$25k	$25k
Document current methods used for the long-term monitoring of living resources (fisheries)	1995	nil	nil
Workshop to develop long-term monitoring of living resources (fisheries)	1996	$25k	$25k

4.4 OCEAN SCIENCE IN RELATION TO NON-LIVING RESOURCES (OSNLR)

4.4.1 Project on Tectonics and its Impact on the Coastal Zone (TICZ)

Thirteen members from nine countries, i.e. Australia, Belgium, China, Fiji, Holland, Indonesia, Japan, Malaysia, Thailand attended the review meeting on planning and implementation of the programme on Ocean Science in Relation to Non-Living Resources (OSNLR).

The revised project (TICZ) was approved at the Second Session of the IOC Sub-Commission for WESTPAC, Bangkok, 25-29 January 1993. It has six pilot projects running currently. Since the project is at the planning stage, the interested scientists have discussed the project and exchanged views several times by correspondence to unify six pilot projects of TICZ under an umbrella.

The project leader participated in several meetings to inform about the project. United Nation World Conference on Natural Disaster Reduction held in Yokohama, May 1994 and International Forum on Eastern Asia Natural Hazards Mapping Project held in Japan Geological Survey in Tsukuba, June 1994 were useful meetings to generate ideas for the formulation of the project.

Significant natural disasters which occurred between 1963-1992 in the eastern, northeast and southeast Asia were earthquakes, floods, tropical storms, landslides and volcano eruptions. The impact reduction of these natural hazards in coastal areas was discussed during the Symposium with a view to developing a comprehensive work plan for the pilot projects.

The review meeting recognized that the understanding of natural disasters occurring in the coastal areas require efforts at three phases or steps. The first is to recognize natural phenomena such as tsunamis, earthquakes. The second is to search for causes of society disasters such as the precipitation ratio for flood. The third is to clarify intensified factors causing damages such as liquefaction phenomena for earthquakes, slope angles for landslides. In the first step, historical records of disasters should be made to show repetition cycle of disaster. In the second step, prediction of disaster can be made to predict scale and area of damages. These kinds of disaster maps have been or will be published by various organizations.

The meeting recognized that the promotion of scientific understanding on physical features through supplementing data of damages should be the main task of the project with a view to indicating the intensified damages.

It was recommended that the next OSNLR workshop should be organized back to back with the 30th International Geological Conference (IGC) in Beijing on 4-14 August, 1996.

4.4.2 Project on Paleogeographic Mapping

As concluded by the 2-day pre-Symposium data compilation workshop, the Paleogeographic Mapping Project has completed its first stage. Seven WESTPAC countries, Australia, China, Indonesia, Japan, Malaysia, Russia, and Thailand have provided their own paleogeographic maps of the Last Glacial Maximum (LGM, 20000-15000 years ago) together with data-base maps, list of sites and list of references.

The Workshop decided that each member of the group will submit their supplementary data by the end of 1994, and the first version of compiled maps for the entire WESTPAC region be completed by the end of March 1996. The final version will be ready by the end of June 1996. The maps, together with data tables, references, as well as contributions from individual countries, are planned to be published as an IOC/WESTPAC monograph in early 1996.

At the same time, manuscripts with maps will be prepared for publication in an international scientific journal.

The meeting recommended that instead of paleogeographic map for the last interglacial (about 125,000 years ago) as originally planned, the next map to be made should be that of the Holocene Optimum (some 6,500-5,000 years ago), which is more urgently needed for prediction of consequences of the future sea-level rise. For the preparation and publication of the next map, it is expected to include more scientists and experts from Viet-Nam, Philippines, Korea and other countries. A data compilation workshop for the Holocene Map is planned in the beginning of 1997.

5. CLOSING

The Chairman of the Local Organizing Committee, Dr. Nontji reported that during 5-day Symposium, 209 participants from 28 countries were present at the Symposium and 124 papers were presented to the plenary and parallel sessions. He also informed the closing plenary that the full texts of 42 papers had been submitted to the Local Organizing Committee by then, and a proceedings was planned to be published. One behalf of all members of LOC, he expressed his appreciation to all participants for their efforts which ensured the success of the Symposium.

Prof. Asai, the Chairman of Scientific Organizing Committee addressed the meeting and congratulated on the success of the Symposium. He summarized the scientific fundings as a result of the Symposium, particularly, in the fields of climate change studies, scientific understanding of the coastal areas and long-term systematic observations.

By thanking the Government of Indonesia for hosting the Symposium and all members of the Scientific Organizing Committee and Local Organizing Committee for their hard work which ensured the success of the meeting, Prof. Su Jilan, the Chairman of IOC/WESTPAC closed the Symposium at 18:00 hours on 25 November 1994.

ANNEX I

PROGRAMME OF THE SYMPOSIUM

Room 1
22 NOVEMBER 1994

0900-1015 Opening Ceremony

- Report by the Chairman of IOC (Dr. Anugerah Nontji).
- Welcome Address by HE Governor of Bali (Ida Bagus Oka).
- Address by the Chairman Of WESTPAC (Prof. Su Jilan).
- Address by the Secretary of IOC (Dr. G. Kullenberg).
- Address by the Chairman of LIPI (Prof. Dr. Samaun Samadikun).
- Opening Address by HE. Minister of Education and Culture ; (Prof. Dr. Wardiman Djojonegoro).

1015-1045 Coffee break

1045-1215 Keynote Addresses
Chaired by Dr. Anugerah Nontji

1. An integrated scientific approach to coastal areas management; (Dr. Don Young Lee)
2. Biogeochemical processes and their impacts on regional biodiversity; (Prof. Dr. Chou Loke Ming)

1215-1400 Lunch

1400-1530 Keynoted Addresses
Chaired by Prof. Dr. Aprilani Soegiarto

3. Dynamics, modelling and prediction of transport phenomena; (Prof. Tetsuo Yanagi)
4. Cimate variability: Predictability and impacts on coastal areas; (Prof. Stuart Godfrey)

1530-1550 Coffee break

1550-1720 5. The scientific rationale for biodiversity maintenance;
(Prof. Brian J. Rothschild)

6. Integrated coastal management and social-economic issues;
(Prof. A.C. Alcala)

1900-2100 Welcome party

23 NOVEMBER 1994

0830-1030 Parallel Session
Biogeochemical processes and its impacts on regional biodiversity: Harmful algal blooms; river input of pollutants; impacts on mangrove, seagrass and coral reef.
Chaired by G. Hallegraeff and F.H.Chang

- Severe fishkills in Hong Kong and the South China Sea caused by *Noctiluca scintilans* blooms;
(Ho Kin Chung)

- Red Tide in the coastal waters of China: an overview;
(Hua Zai)

- Harmful algal blooms in Chinese coastal waters: an overview;
(Qi Yu-Zao)

- Distribution of *Gymnodinium* cf. *breve* and shellfish toxicity in late 1993, in Hauraki Gulf, New Zealand;
(F.H. Chang, J. Sharples, D. Till and M. Oliver)

- Blooming of the dinoflagellate, *Pyrodinium bahamense*, in Kao Bay (North Moluccas);
(N.N.Wiadnuana *et al.*)

- Preliminary results of and eco-physiological study on the *Pyrodinium* tides in Manila Bay, Philippines;
(R.A. Corrales and R. Crisostomo)

- Distribution of resting of toxic dinoflagellate *Pyrodinium bahamensa* var. *compressum* in Manila Bay, The Philippines;
(Y. Fukuyo *et al.*)

- Distribution of resting cysts of *Pyrodinium Bahamensa* var. *compressum* in Cancabato Bay, Leyte, Philippines;
(Marasigan, *et al.*)

1030-1100 Coffee break

1100-1230 Parallel Session (Cont.)
Chaired by Y. Fukuyo and M. Hungspreugs

- Toxic accumulation of shellfish during bloom of *Dinophysis fortii* and *D.acuminata* in Japan;
(S. Sato *et al.*)

- *Nodularis spumigena*: A toxic, bloom-forming cyanobacterium in Australian estuaries and coastal inlets;
(S.I. Blackburn)

- Progress report on Unesco Monograph on harmful marine microalgae;
(Gustaff M. Hallegraeff)

- Phytoplankton pigments as biomarkers for tracking phytoplankton- derived carbon in coastal environment;
(Pichan Sawangwong)

- Nutrient flux from mangroves;
(Gullaya Wattayakorn)

- Study on plankton productivity at mangrove and its surrounding water in Kao Bay, North Moluccas;
(A. Sediadi and N.N. Wiadnyana)

1230-1400 Lunch

1400-1530 Parallel session (Cont.)
Chaired by Kumaras Kay Kalim and Gullaya Wattayakorn

- Some aspects about biogeochemical processes of sulfur and its effects on the mangrove ecosystem in the north of Vietnam;
(Nguyen Duc Cu)

- Biogeochemistry for tropical mangrove soils: Recent advances and implications for management;
(D.M. Alongi)

- Impact of human pollution on mangrove and landuse change at Ban Don Bay, Surat Thani Provice, on the east coast of southern Thailand;
(Surachai Rattanasermpong, Rasamee Suwanwerakamtorn and Absornsuda Siripong)

- Pichavaram mangrove ecosystem, human impacts and management;
(J.K. Patterson Edward and K.Ayyakkannu)

- In-situ measurements of nutrients in the Gulf of Thailand;
(Darasri Dowreang, Pitan Singhasaneh, Per-Erik Soras and Ulf Winther)

- Input from the Chao Phraya and the Bang Pakong rivers into the Gulf of Thailand;
(Wilaiwan Utoomoprupornm, Manuwadi Hungspreugs, Sirichai Dharmvanij and Anond Snidvongs)

1530-1600 Coffee break

Parallel session (Cont.)

Chaired by M.A. Aziz and Pham Van Ninh

- Water pollution in the Mekong and Red River mouth areas;
(Pham Van Ninh)

- Nutrient input from the major river tributaries of the National Capital Region (NCR) to Manila Bay;
(Maria Consolation Nasol Capino)

- Study on pollution on Jiaozhou Bay;
(Guo Yugui)

- Marine pollution monitoring;
(Kumaras Kay Kalim and Papua New)

- Marine water quality monitoring;
(M.A. Aziz)

- A measure to prevent the progress of organic pollution on the sea bed below the fish net pens with biological activities of a Polychaete, *Capitella* sp.1;
(Hiroaki Tsutsumi, Shigeru Montani, Charumas Chaaereonpanich and Horoshi Koube)

- Atmospheric versus riverine input of nutrient elements to the NW Pacific coastal oceans;
(Jing Zhang)

- Influence of the ITCZ on the themocline water from the subtropical to the equatorial Pacific Ocean;
(P.LU and J.P. Mc Creary Jr.)

24 NOVEMBER 1994

0830-1030 Parallel session (Cont.)
Chaired by Ahmail and Xu Kuncan

- Large-scale transport of chemical elements in aerosols over the east coast of asia;
(A.N. Medvedev, M. Uemastsu, G.M. Kolesov and V.V. Anikiev)

- The influence of marine environment on the inputs of nutrients and trace elements through 'wet' and 'dry' deposition; A remote island site investigation in the South Pacific;
(K. Koshy, G. Ayers, R. Gillet and P. Anikiev)

- Wet deposition of atmospheric major plant inorganic nutrients at the midwestern coast of Korean Peninsula;
(G.H. Hong, D.J. Kang, C.S. Chung and S.H. Kim)

- Sewage outfall and sediment siltation;
(Dongfeng Xu and Weiyi Xu)

- Attitude of the residents along the river banks and Manila bay coastal area towards the river revival project;
(Felicito O. Nisperos)

- Xenobiotically active industrial products in the coastal and marine environment;
(C.P. Mathews)

- Polyaromatic hydrocarbon identification in surficial sediment of Langnga coastal area, SW. Sulawesi;
(Alfian Noor)

- Pollution status of aquaculture areas by assessing the sedimentary non residual trace metal concentrations;
(Ismail Mat and Mohd Jamil Maah)

1030-1100 Coffee break

1100-1230 Parallel session (Cont.)
Chaired by Dharma Arief and Ismail Mat

- Investigation of Heavy metals in the major river tributaries of Manila Bay;
(Luzviminda V. Ramallosa)

- Use of Bivalves for pollution monitoring in south coastal water of P.R. China;
(Xu Kuncan, Zhen Changchun and Sun Shuyun)

- Heavy metals in bivalve of Chinese coastal zones;
(Su Mei Liu, Zhang and Xin Yang)

- Heavy Metal in sediments and biological samples from west coast of Peninsular Malaysia;
(Ahmad Ismail)

- The determination of the heavy metals in seagrass (*Porterasia coarctata* Takeoka)as a potential biological monitor in Deltaic Sundarbans, northeast coast of India;
(S.K. Sarkar, B. Bhattacharya and S. Debnath)

- Acute toxicity of cadmium and chromium to tropical fish: milkfish (*Chanos chanos*);
(Yeti Darmayati and Dwi Hindarti)

1230-1400 Lunch

1400-1530 Parallel session (Cont.)

Chaired by Rhodora Corrales and Abdul Ghofar

- The acute toxicity of cadmium to the tiger prawn (*Penaeus monodon*) and banana prawn (*P. merguiensis*);
(Dwi Hindarti and Yeti Darmayati)

- Species composition and distribution of seagrasses at Kuta and Gerupuk Bays, south coast of Lombok Indonesia;
(Wawan Kiswara)

- The 1991 coral reef bleaching in the Andaman Sea, Thailand;
(Ukkrit Satapoomin, Niphon Phongsuwan and Hansa Chansang)

- Patterns of spatial distribution, diversity and cover of corals in Pulau Seribu National Park, implications for the design of core coral sanctuaries;
(Rili I. Djohani)

- Geographic location influlences coral comparison between Bali and Sulawesi, Indonesia;
(R. van Woesik)

- China's marine biodiversity strategy;
(Huang Zongguo and Gu Deyu)

1530-1600 Coffee break

1600-1800 Reviews of plans and implementation of the WESTPAC scientific programmes and project *Marine Pollution Research Monitoring*
Convened by Prof. M. Hungspreugs

PROGRAMME OF THE SYMPOSIUM
ROOM 2

23 NOVEMBER 1994

0830-1030 Parallel session
Dynamics, modeling and prediction of transport phenomena; nearshore current and sediment transport; continental circulation; tides and tidal phenomena; stom surges and tsunamis
Chaired by Mohd. Nasir Saadon and Absornsuda Siripong

- Beach erosion nearshore sediment dynamics at Bang Thao Bay, Phuket;
  (Siaichai Darmvanij, Absornsuda Siripong and Supichai Tangjaitrong)

- Conservation of the coral sand in Sanur and Nusa Dua Beaches in Bali;
  (Syamsudin and Kardana)

- Coastal resources in Western Samoa, sand and gravel;
  (Tailia, L. and Tiyimea, A.K.)

- Solute transport within sediments;
  (Ian T. Webster)

- Hydronumerical modelling of typhoon surge along the beach of Vietnam;
  (Din Van Manh)

- The Banyuwangi tsunami Wave on June 3, 1994;
  (Hadikusumah)

- Impact of the disaster tsunami Banyuwangi 1994;
  (Helfinalis)

- Coastal protection through prediction of floods during the passage of a tropical cyclone;
  (Rolu P. Encarnacion)

1030-1100 Coffee break

1100-1400 Parallel session (Cont.)
Chaired by Keisuke Taira and Boonlert Archvanrahuprok

- The Seto Inland Sea coast monitoring program using NOAA AVHRR sea surface temperature estimation and validation;
(Kozai Katsutoshi, Sakaida Futoki, Kawamura Hiroshi and Yanagi Tetsuo)

- The temperature and salinity profiles in the east coast of Peninsular Malaysia during the Northeast Monsoon;
(Mohn Nasir Saadon and Abdul Hamid Yasin)

- Calculation of the monthly mean ocean currents of the Gulf of Thailand;
(Boonlert Archevarahuprok)

- The Seawatch Thailand System, an operational marine environmental monitoring and forecasting system;
(Darasri Dowreang, Pitan Singhasaneh, Per-Erik Soras and Peter Schjolberg)

- Seawatch Indonesia: A marine environment monitoring and information system within the GOOS Concept;
(H. Uktolseya, Sudariyono, P. Sumaryo T.A. Adibroto, M. Hutomo and E. Soras)

- Numerical model for circulation in the upper Gulf of Thailand;
(Pramot Sojisuporn)

1230-1400 Lunch

1400-1530 Parallel session
Dynamics, modelling and prediction of transport phenomena; nearshore currents and sediment transport; water circulation; marine pollution
Chaired by Jing Zhang and Mitsuo Uematsu

- Observed mid-depth currents in Makassar Strait, June 1993- June 1994 and along- strait sea level slope;
(Luick, J.L.)

- A comparison of the water circulation in the Gulfs of Thailand, Carpentarail and Papua;
(Eric Wolanski)

- Numerical experiments on the circulation of the South China Sea;
(Alejandro Livio Cameriengo and Monica Ines Demmler)

- Determination of an upper bound for the wind stress in a layered model;
(Alejandro Livio Cameriengo and Monica Ines Demmler)

- Mooring observation of coastal current off Kuala Terengganu, Malaysia;
(Keisuke Taira, Mohd. Nasir B. Saadon and Shji Kitagawa)

- Experimental study of water carbonate system in largest river estuarine of West Pacific;
(V.F. Mishukov and S.G. Sagalaev)

1530-1600 Coffee break

1600-1800 Parallel session (Cont.)
Chaired by Hideo Kagami and E. Wolanski

- Terrestrial and marine sediments in the Gulf of Papua: Organic carbon, sulfur and iron relationships;
(Gregg J. Brunskill and Dan M. Alongi)

- Geographical distribution of dissoved inorganic selenium in sea water;
(Sri Juari Santosa and Shigeru Tanaka)

- The transfer of radionuclides in marine food web;
(Cai Fulong)

- Deposition of atmospheric particles to the east coast of Asia;
(Mitsuo Uematsu and Nobuharu Komai)

- Atmospheric input in the Kuroshio Ocean Area and the West Pacific;
(Fenlan qian, Hongijian Yu, Youchang Lan, Zhi Chen and Mingyu Zhou)

- Experimental study and computer modelling of oil degradation in north-west Pacific regions;
(V.F. Michoukov, L.G. Zelenina and O.V. Abramova)

- Computer mapping of Tarawa Atoll;
(B.M. Larue)

- The shallow and deep water moorings used in the ASEAN-Australia Regional Ocean Dynamics Expedition 1993/1994;
(G. Cresswell; F. Boland; D. Mac Laughlin and K. Miller)

24 NOVEMBER 1994

0830-1030 Parallel session
Dynamics, modelling, geological processes, water circulation, sedimentation and biological aspects
Chaired by G.L. Brunskill and O.S.R. Ongkosongo

- Rapid flooding events due to episodic sea level rises and their impact on the evolution of Texas coastal environments;
(Siringan, F.P. and J.B. Anderson)

- Quaternary eustatic sea-level variation and the lost epicontinental sea in Indonesian Maritime Island: Responses and impacts to the global climate changes;
(Wahyoe S. Hantoro)

- Sedimentation in northern part of lake Tonle Sap, Cambodia;
(Shinji Tsukawaki, Masafumi Okawara and Kim-Leang Lao)

- Environmental instability of West Pacific marginal seas;
(Wang Pinxian)

- Neotectonics of the Gulf of Thailand;
(Sangad Bunopas)

- Sedimentation of the 1960 Chile earthquake tsunami deposits in Matsushima Bay, Northeast Japan, and its ecological impacts;
(Shinji Tsukawaki and Ayahide Kamenmaru)

- Marine terraces and differential uplift along the margin of active plate;
(Wahyoe S. Hantoro)

- Tectonic approach on changes surface water circulation between the tropical Pacific and Indian Oceans;
(Susumu Nishimura and Indonesian Committee of GCP335)

1030-1100 Coffee break

1100-1230 Parallel session (Cont.)
Chaired by S.J.M. Blaber and Lokman Shamsudin

- Coastal hazard maps;
(Hideo Kagami)

- Bioproduct extraction from local mudskipper species as health food for human and animal consumption;
(L. Shamsudin, Mohd. A. Ambak, M. Yusof, A.A. Aziz and Y. Shukri)

- The biochemical and nutritional properties of certain indigenous Malaysian Bacillariophyceae as food organisms for fishlarval rearing in local hatcheries;
(L. Shamsudin, Mohd. A. Ambak, M. Yusof, A.A. Aziz and Y. Shukri)

- Observation of abundance and density of fish on designed modules of artificial reef;
(Umar S., A. Mohd. Azmi and Mohammad Zaini)

- Taxonomy, Biodiversity and conservation of the fishes of the Straits of Malacca;
(A.K.M. Mohsin, Mohd. A. Ambak, Mohd. Z.M. Said)

- Unjams (FADS) as substrates for food organisms;
(Sakri Ibrahim, Mohd. A. Ambak and Lokman Shamsudin)

1230-1400 Lunch

1400-1530 Parallel session (Cont.)

Chaired by M. Hutomo and S. Sato

- Studies on live baitfish for the tuna industry in eastern Indonesian water;
(D.A. Milton, S.J.M. Blaber and N.J.F. Rawlinson)

- The biology, ecology and life-cycle of Terubok(*Tenualosa Toli*) in Serawak;
(S.J.M. Blaber and DF. A. Milton)

- Aggregation of cephalopods on a specific designed of artificial reef modules;
(Mohammad Saini and S. Umar)

- Chepalopods of Nusa Tenggara, with notes of probable cause of resource depletion;
(Abdul Ghofar)

- Are the coral reefs along the coast of west Sumatra seriously damaged?;
(Andreas Kunzmann and Yempita Efendi).

- The importance of coral reef as seaweed resources in Indonesia; (Wanda S. Atmadja)

1530-1600 Coffee break

1600-1800 Reviews of plans and implementations of the WESTPAC Scientific Programs and Project *Ocean Science in Relation to Living Resources*
Convened by Dr. Derek Staples

PROGRAMME OF THE SYMPOSIUM
Room 3

23 NOVEMBER 1994

0830-1030 Parallel session
Climate variability, predictability and impacts: Long term records; ENSO and the sea level signal; climate change impacts on the coastal zone and biodiversity.
Chaired by Takashige Sugimoto and S.L. Hautala

- Variations in atmospheric and oceanic CO_2 in the north western Pacific and estimation of the Co_2 flux at the air-sea interface;
(Akihiko M. Murata and Michio Hirota)

- Transport and storage of CO_2 in the Indian Ocean and ocean circulation model for carbon cycle;
(Pu Yipen, Wang Mingxing, Zeng Qingcun and Zhang Xuechong)

- Air temperature variations and ENSO effects in Indonesia, the Philippines and El Salvador;
(J.R.E. Harger)

- Effect of ENSO on the chlorophyll density of coastal and offshore surface water in the northwestern subtropical Pacific in winter;
(Takashige Sugimoto)

- Spatial time distribution of chlorophyll-a in the western tropical Pacific Ocean;
(Huang Linagmin)

- Impacts of climate change on the coastal resources and environment at Surat Thani Province, on the east coast of southern Thailand;
(Absornsuda Siripong, Takashige Sugimoto and Darasri Dowreang)

- A structural means to protect the coastal zones against severe ocean dynamics and climate-case study, Malaysia; (Abdul Aziz Ibrahim)

- Sea level trends and consequent impact on shoreline changes; (K.V.S.R. Prasad)

1030-1100 Coffee break

1100-1230 Parallel session
Special session of Western Boundary Currents observations and models of the Indonesian seas and the eastern Indian Ocean
Chaired by Toshio Yamagata

- Water masses of the Indonesian Seas Throughflow; (Arnold I. Gordon and A. Gani Ilahude)

- Water mass distribution on isopycnals in the Indonesian Seas; (Susan L. Hautala, Joseph L. Reid and Nan Bray)

- Water masses study of the JADE 1992 Experiment through hydrological data and freons measurements; (M. Fieux, A.G. Ilahude and R. Molcard)

- Tidal mixing in the Indonesian seas; (Amy Field)

- Tidal current in the Indonesian seas and its effect on the transport and mixing processes; (T. Awaji, T. Hatayama, K. Akimoto and N. Imasato)

- Geostrophic transport and seasonal variability of the Pacific-Indian Oceans Throughflow; (M. Fieux, A.G. Ilahude and R. Molcard)

1230-1400 Lunch

1400-1530 Parallel session (Cont.)
Chaired by Arnold Gordon

- Seasonal variations of salinity in the mixed layer of the Indonesian Seas; (T. Miyama, T. Awaji, K. Akimoto and N. Imasato)

- The Timor Passage: its contribution to the Indo-Pacific Througflow; (R. Molcard, J. Banjarnahor, M. Fieux and A.G. Ilahude)

- Banda Sea and the Indian Ocean in the throughflow circulation;
(A.A. Ilahude, J. Banjarmahor, M. Fieux and R. Molcard)

- Surface current field in the tropical Indian Ocean and the seas adjacent to Indonesia observed with surface drifters;
(Yataka Michida and Hiroyuki Yoritaka)

- Large-scale sea level wind and thermocline variations in the Indonesian throughflow region;
(Nan Bray, Susan Huatala and John Pariwono)

- Annual and semiannual variations in the eastern Indian Ocean: observation and simulation;
(Toshio Yamagata and Yukio Masumoto)

1530-1600 Coffee break

1600-1715 Parallel session (Cont.)
Chaired by David Halpern

- Simulated seasonal variability of the Indonesian Throughflow;
(Yukio Masumoto and Tishio Yamagata)

- Seasonal transport variations in the Indonesian seas;
(T. Miyama, T. Awaji, K. Akimoto and N.Imasato)

- Extra-tropical induced variations in the Indo-Pacific Througflow, and consequences for the Southern oscillation;
(Roxana C. Wajsowicz)

- Choked flows from the Pacific to the Indian Ocean;
(Doron Nof)

- A project to provide marine meteorological/oceanographic services for marine environmental manager in ASEAN countries;
(P.E. Dexter and J.A. Withrow)

24 NOVEMBER 1994

0830-1030 Parallel session
Special session of Western Boundary Currents, observation and model of the tropical Pacific Ocean.
Chaired by Roger Lukas and O.Roswintiarti

- Annual cycle of surface winds over the western Pacific Ocean;
  (D. Halpern)

- Transport of the New Guinea coastal undercurrent through the Vitiaz Strait March '92-April '93;
  (S.P. Murray, H. Huriburt, J. Kindle & E. Lindstrom)

- A hydrographic in the southern Philippine Sea: from WOCE Hydrographic Programme Section PR1S PR24;
  (Kawano, T. etc.)

- Application of the ocean acoustic tomography to the measurement of oceanic conditions off Mindanao Island;
  (A. Kaneko, Gang Yuan, I. Nakano and H. Fujimori)

- Acoustic measurement of ocean current averaged over 10 km rang;
  (K. Taira and T. Takeuchi)

- Heat anomaly transport in the northwestern Pacific;
  (A. Ostrovskii and L. Pieterbarg)

- Inerannual fluctuations of the bifurcation of the North Equatorial Current in the western Pacific;
  (J.Y. Potemra, R. Lukas and B. Qiu)

- On the seasonal and interannual bifurcation of the North Equatorial Current along the Pacific western boundary;
  (Bo Qui, J.T. Potemra and R. lukas)

1030-1100 Coffee break

1100-1300 Parallel session (Cont.)

Chaired by A.G. Ilahude and T. Kawano

- Annual mean heat budget and the role of circulation in the tropical western Pacific Ocean in a Global GCM;
  (T. Qu, G. Meyers and J.S. Godfrey)

- Numerical simulation of thermal and wind-driven tropical Pacific;
  (Z. Fang, S. Nakamoto, K. Ueyoshi, J. Roads A. Miller, J.M. Obertiuber, K. Muneyama, T. Nakanishi and S. Ishii)

- A couple TOGA model;
  (S. Ineson and M. Davey)

- ENSO and the sea level signal;
  (W. Kanbua)

- ENSO variations and drought occurrence in Indonesia and the Philippines;
  (J.R.E. Harger)

- The teleconnection between equatorial Pacific sea-surface temperatures and convection over Indonesia during ENSO;
  (O. Roswintiart and B. Hasyim)

- Impacts of the western Pacific warm pool on the East Asian summer monsoon;
  (Huang Ronghui)

- Modelling of the effects of SST in the tropical Atlantic on the blocking high and the winter monsoon in East Asia;
  (Lu Riyu and Huang Ronghui)

1300-1400 Lunch

1400-1500 Parallel session
Special Session of Western Boundary;
Marginal seas linked with the northwestern Pacific Ocean.
Chaired by J.H. Yoon and W. Koterrayma

a. South China Sea Circulation

- Database oceanography-seasonal variations in the hydrography of the South China Sea;
  (Z. Aziz)

- Circulation in the South China Sea. The observation and simulation;
  (Y. He, T. Yamagata, G. Guan and Y. Masumoto)

- Numerical modelling of current dynamics and low-ferquency oscillations in the South China Sea;
  (A.L. Berestov, O.V. Kondrateva and F. Zhou)

- Numerical study on the interrelation between the Kuroshio and the current of the northern South China Sea;
  (Li Rongfeng, Gou Dongjiang and Zeng Qingcun)

b. Japan Sea circulation

- The Japan Sea dynamics inferred from NOAA AVHRR infared images;
  (A. Ostrovskii)

- Some features of winter convection in the Japan Sea;
  (Y-H. Seung, J-H. Yoon and M. Danchenkov)

- Robust diagnostic modelling of Japan Sea circulation;
  (Y-H. Seung and J-H. Yoon)

- Field test of a towed vehicle "Flying Fish" developed for physical and chemical measurement in the ocean upper mixed layer;
  (W. Koterayama, S. Yamaguchi and M. Nakamura)

1600-1630 Coffee break

1630-1800 Reviews of plans and implementations of the WESTPAC Scientific Programs and Project: *Ocean dynamic and climate*
Covened by Prof. T. Yamagata

ANNEX II

ABSTRACTS OF SCIENTIFIC PAPERS

SCIENTIFIC APPROACH TO INTEGRATED COASTAL ZONE MANAGEMENT

Dong-Young Lee
Korea Ocean Research and Development Institute

Keynote speech

In recent years, the utilization of the coastal areas for various activities of mankind has been increasing for most of the coastal countries and this tendency is expected to increase in the future. In many countries, several projects such as harbor constructions, coastal industrial complex developments, land reclamations, artificial islands, and other coastal constructions are in progress along the coast. One of major concerns in the development of coastal area is how to maximize the benefits provided by the coastal development and to minimize the negative impacts of the development.

Legal, institutional, social aspect of coastal zone management has been emphasized and various programs have been developed. Scientific approach of the coastal zone management is also important for the proper management of the development and preservation of the coastal area. For each coastal development projects, scientific information on the ocean and coastal environmental conditions is required for each stage of the development for the proper planning, optimal design of the coastal structure, safe and economical construction and operation of the structure and the preservation of marine environments.

Coastal environmental parameters for wide area of interest, required by the users can be obtained by integrating modern technology of field data acquisition and numerical ocean prediction. It is important for each agency and organization which are involved in the coastal development to realized that development and management of the coastal area should be based on the proper understanding and predictability of coastal environmental conditions and possible changes in the coastal environments caused by the coastal development for proper planning, designing, implementation of the coastal zone development and preservation of the coastal zone marine environments.

The basic information needed in the development of the coastal area can be obtained more efficiently by systematic coastal observing system at a national level together with local observing system designed for the local coastal development program. Proper development of a national coastal monitoring system is essential and such system needs to be properly linked with local coastal observing system. In this presentation, emphasis will be put on how to efficiently provide the basic coastal environmental conditions that are needed for the efficient coastal management. Problems and concerns in the development of coastal observing system will be discussed based on the experiences obtained while carrying out projects on the coastal observing systems last several years by the Korea Ocean Research and Development Institute and suggestion for the integrated comprehensive monitoring and prediction system will be addressed.

The necessity of the international cooperation between the neighboring countries in a region is essential to establish fundamental coastal monitoring and service system to be able to produce the essential coastal environmental information for each country. The necessity of a regional ocean observing system for the scientific management of the coastal zone of individual countries will be emphasized in connection to the effort of International Oceanographic Commission (IOC) in establishing the Global Ocean Observing System (GOOS).

BIOGEOCHEMICAL PROCESSED AND THEIR IMPACTS ON REGIONAL BIODIVERSITY

L.M. Chou
Department of Zoology
National University of Singapore

keynote speech

Earth is like a chemical factory in which elements are distributed temporally and spatially through natural cycles. Seawater is an efficient transport and solvent agent, cycling chemicals in different form between sources and sinks. Within the marine environment itself, chemical reactions interact with biological, physical and geological processes. In addition, materials are exchanged between it and the land, the air and the bottom sediment. Chemicals, particularly organic compounds have a great impact on biological activity as they make up the tissues of marine organisms. They are also the primary source of food for the heterotrophs. Many of these marine sediments are affected by the presence of organic matter which also forms a source of energy to benthic organisms, in the water column, sinking particles are quickly coated by a film of organic matter which absorbs metal ions and attracts heterotrophic bacteria. Organisms obtain chemical energy by degrading organic compounds. The great number of anabolic and catabolic reactions enable marine organisms to produce a large variety of organic compounds. Marine biogeochemical processes are complex and have an important influence on biodiversity. The biogeochemical processes operation within them. In addition, regional biodiversity is further influenced by other functions such as the input of pollutants, the rapid removal of marine organisms and the destruction of habitat integrity.

DYNAMICS, MODELING AND PREDICTION OF TRANSPORT PHENOMENA

Tetsuo Yanagi
Department of Civil and Ocean Engineering
Ehime University Matsuyama, Japan

keynote speech

It is very important to clarify the characteristics of material transport and to predict it in the coastal sea. In order to predict the material transport, we have to reproduce at first the current field in the coastal sea which governs the material transport. The current related to material transport mainly consists of tidal current and residual flow. The residual flow in the coastal sea is composed of tide-induced residual current, wind-driven current and density-driven current.

As one example, the dynamics and modeling of material transport in the Yellow/East China seas are discussed in this paper. At first the tide and tidal current are reproduced by the two-dimensional numerical model and the seasonal variation of residual flow is investigated with use of three-dimensional diagnostic numerical model. The results on seasonal variation of residual flow are verified with use of sea surface topography data obtained by TOPEX/POSEIDON. At last, the numerical calculation on the suspended sediments transport from the Huanghe and the Changjiang is Tried. The calculated sedimentation pattern nearly coincides with the results of field observation.

CLIMATE VARIABILITY : PREDICTABILITY AND IMPACTS ON COASTAL AREAS

J.S. Godfrey
CSIRO Division of Oceanography, Australia
keynote speech

The TOGA (Tropical Oceans - Global Atmosphere) Decade, from 1985 - 1994, is now nearly at an end. The aim of this international effort was to improve our understanding of the ways in which the tropical oceans and the global atmosphere interact with one another to produce large interannual variations in climate - particularly those associated with the El Nino-Southern Oscillation (ENSO) phenomenon.

One simple and direct outcome of the TOGA Decade has been the development of models (such as the Cane-Zebiak model) which are physically quite simple, but which nevertheless have demonstrable skill in forecasting climate variations one or more seasons in advance. The basic physical principles of such models, and recent variants on them, are discussed in qualitative terms. Such models have now been in use for some years. Their track record so far is briefly assessed, and international plans for improving on these models are outlined.

The impact of climate variability on the coasts of one country (Australia) will be discussed, and present ideas on how Australia might capitalize on the new capability for climate prediction will be considered.

INTEGRATED COASTAL MANAGEMENT AND ITS SOCIOECONOMIC ISSUES

Angel C. Alcala
Environment and Natural Resources. Republic of the Philippines

keynote speech

In most developing countries, economic and socio-political growth rely heavily on the availability of natural resources. Poverty and malnutrition can, be addressed by securing greater self-sufficiently in food. Since fish constitutes 50% of the animal protein staple in the Southeast Asian region, aquatic resources have become a primary concern.

The need to protect and preserve our fast-diminishing coastal resources has become increasingly urgent. Successful management of these resources hinges on the resolution of urgent socio-economic issues, among them: the need to focus on long-term ecological perspective rather than short-term economic benefits in management; allowing optimum returns from municipal or artisanal fishery; diffusing conflict between municipal fishermen and commercial trawlers; and the imbalance in the demand-supply ratio of scarce coastal resources resulting from rapid population growth.

This broad range of issues requires an integrated coastal resource management approach which is interdisciplinary and multisectoral in character. The hear of this management approach lies in empowering our coastal communities. It requires, most of all, strong political will and leadership.

SEVERE FISHKILL IN HONG KONG AND THE SOUTH CHINA SEA CAUSED BY *NOCTILUCA SCINTILLANS* BLOOMS

Ho Kin Chung
Open Learning Institute of Hong Kong, Mongkok
Kowloon, Hong Kong

In late April 1992, widespread algal blooms were observed in Hong Kong's eastern waters and the South China coast. The algal blooms resulted with temporary closure of bathing beaches and a severe kill of marine organisms in the affected waters. As reported by aquaculturists, algal bloom persisted in one fish culture zone for more than one week and 4.5 tonnes of cultured fishes, mainly grouper and sea bream, were killed by deoxygenation. The loss amounted to fifty thousand US dollars. Moreover, more one million swimmers were affected by th closure of 11 gazetted beaches in Hong Kong during this event.

While the blooming of *N. scintillans* in winter to early spring is regarded as a seasonal phenomenon, officials of the Hong Kong government concluded that the increasing frequency of the *Noctiluca* red tide was mainly due to nutrient enrichment resulting from increases in sewage discharges. Field studies showed that blooms of *N. scintillans* usually occur in the fronts caused by seawater mixing or upwelling. A stirring up of bottom sediments, which contain high levels of organic matter and which can serve as food for the phagocytic *N. scintillans*, may be a primary factor controlling the abrupt increase of the organism. Bioassay in the laboratory showed that *N. scintillans* favors a temperature of 16-24 C and a salinity of 28-32 ‰. These results coincide with the normal temperature and salinity ranges in the South China Sea during winter.

RED TIDES THE COASTAL WATERS OF CHINA : AN OVERVIEW

Hua Zai
National Marine Data an Information Service - SAO, Tianjin, China

Along with the rapid development of industry and agriculture in the Chinese coastal areas, and the notable increase in the population of the coastal cities in China, industrial wastes, agricultural wastewater and domestic sewage have been discharged in great amount into rivers of directly into the sea. The coastal waters of China especially the waters of bays, inlets and estuaries have been seriously polluted and overfertilized. As a result, red tides have occurred frequently and widespreadingly in the coastal waters of China. The red tides have brought about pernicious effects on the resources and production of sea fishery as well as the public health in China. The red tide is becoming a serious marine environmental problem in the coastal waters of China.

This paper introduces the red tides recorded in the coastal waters of china and the red tide causative organisms in the coastal water of China, and discussed the characteristics of the red tides occurred in the waters. The research projects and activities on the red tide in China are reviewed. Meanwhile, in order to minimize the sea fishery loss caused by the red tides, and to protect the public health, this paper also puts forward some suggestions of preventing and controlling red tide occurrences in the coastal waters of China according to the present condition of China.

HARMFUL ALGAL BLOOMS IN CHINESE COASTAL WATERS: AN OVER VIEW

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Rapid growth in coastal China has created serious pollution problems, habitat losses, and frequent harmful algal blooms (HAB). The incidence of HAB outbreaks has become more frequent and is covering increasingly large areas.

HAB affects the coastlines of all China seas, especially severe in the embayments and areas where rivers enter the sea. There has also been speculation that the rapid expansion of mariculture, specifically the alteration of coastal wetlands or shrimp and fish farming, is making the eutrophication problem more severe, leading to more HAB. Consequentially, the discharge of mariculture/mixing aging water leads water eutrophication, decreases the biodiversity index and is the important source of new-productivity (increasing biomass), meanwhile the excess N and P in the inner bay.

Two species of algal blooms were recorded newly in China : *Heterosigma alashiwo* in Dalian Bay, northern China (1985-1987) and *Chattonella marina* in Dapeng Bay, South China Sea (1991). Two important toxic cysts (*Gymnodinium catenatum* and *Pyrodinium bahamense)* were found among the cysts survey along he coast of East and South China Sea. It is suggested that they may transform from out of China by international maritime activities and they have great significant in assessing toxic algal blooms in China.

Physiological ecology studies of red tide species were carried out in such as cysts formation, germination life-cycles, growth characteristics, nutrient requirements, diurnal vertical migration (DVM) and so on. Moreover, autecology studies on *Noctiluca scintillans* and *Sk. coatatum* by means of CEPEX and in situ investigation have been carried out to explore the mechanisms of their blooms.

Three strains of *A. tamarense* prove to be toxic, and their cyst-toxi content were also examined.

Finally, the comprehensive research perspective is viewed.

DISTRIBUTION OF *GYMNODINIUM* CF. *BREVE* AND THE SHELLFISH TOXICITY IN LATE 1993, IN HAURAKI GULF, NEW ZEALAND

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From 13 to 16 December 1993, a plankton survey was conducted between Cape Brett and outer Hauraki Gulf on the northeast coast of North Island, New Zealand. This is a region where human symptoms of neurotoxic shellfish poisoning (NSP) were first reported in the early 1993, and where low levels on NSP have consistently been detected ever since. In the December 1993 survey, *Gymnodinium* cf. breve was the only toxic species identified in the nearshore waters, and across the continental shelf to the open ocean in the Gulf. The abundance and distribution of this NSP-producing dinoflagellate showed relatively low cell concentrations (up to 1500 cells l^{-1}) in several areas, both in the Gulf, and in offshore waters to the east of Coromandel Peninsula. This appears to generally match with the low levels of NSP that have been detected in shellfish along the coastline between Cape Brett and outer Gulf in the same period. The amount of NSP detected in shellfish, in the routine toxin monitoring programme, was in the range of 20 to 60 MU 100 g^{-1} shellfish tissues, and only scallops *(Chlamys zelandiae)* and tuatuas *(Amphidesma subtriangulatum)* showed the toxicity and also levels exceeding the regulatory level of 20 MU 100 g^{-1}. It is suggested that the intrusion of oceanic waters into the Hauraki Gulf observed in the December 1993 was responsible for the introduction of this species to the Gulf.

BLOOMING OF THE DINOFLAGELLATE, *PYRODINIUM BAHAMENSE* IN KAO BAY (NORTH MOLUCCAS)

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Samples were collected for cell counting between June 1993 and April 1994 in KAO Bay, North Moluccas (Eastern Indonesia). The objectives were to evaluate the fitoplakton species occurring in high density, after first information from coastal communities who reported an apparation of red water in Kao Bay, Results showed a blooming of *Pyrodinium bahamense* that cause the "Paralytic Shellfish Poisoning" (PSP), which plays the important role in the red tide phenomenon in this bay. The maximum abundance of this dinoflagellates varied from 15 to 20 x 10^6 cell m 3 (75 to 90 % of total fitoplakton). It appears that the changes of hydrological factors and climate may have stimulated the blooming of this toxic dinoflagellate.

PRELIMINARY RESULTS OF AN ECO-PHYSIOLOGICAL STUDY ON THE *PYRODINIUM* RED TIDES IN MANILA BAY, PHILIPPINES

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Harmful algal blooms in Manila Bay, Philippines, have been reported as causing negative health impacts and economic loses in Metro Manila area and other coastal towns surrounding the bay since 1987. Recent accounts point to *Pyrodinium bahamense* var. *compressum* as the major causative organism of the toxic red tides in the area. Some preliminary results of an on-going eco-physiological study aimed at (1) estimating the cyst density of the causative organism in selected sites of the bay and (2) testing the variability of these collected cysts from the sediments will be presented. Results will help elucidate the origin/mechanisms of *Pyrodinium* red tides in Manila Bay thereby help in the management aspect of this phenomenon.

THE DISTRIBUTION OF RESTING CYSTS OF TOXIC DINOFLAGELLATA *PYRODINIUM BAHAMENSE* AND *COMPRESSUM* IN MANILA BAY, THE PHILIPPINES

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Pyrodinium bahamense var. *compressum*, a marine dinoflagellate, is the causative agent of paralytic shellfish poisoning on human being who ingested the toxin concentrated in mussels and oysters in tropical western Pacific countries. In Manila Bay, Philippines, the species bloomed in 1988 for the first time over the west coast. Subsequent blooms from 1991-1993 were extensively spread throughout the bay and gave serious problem in coastal fisheries.

The horizontal and vertical distribution of resting cysts of *P. bahamense* in sediment were investigated to compare the distribution of motile cells in waters of Manila Bay. The resting cysts work is considered as a survival tolerant tool for inadequate ambient environment, and as seeds for the following blooming. Therefore, data on their distribution provide basic knowledge for elucidation of blooming mechanisms.

The survey was undertaken in July an August 1993 at 20 stations in Manila Bay. Bottom sediments were collected by a KK corer (4 cm o) from all stations and by a long corer (8 cm o) at 4 stations and then were treated palynologically to cysts. Concentrated specimen were observed under microscope to count *P. bahamense* cysts. Sediment age was analyzed using ^{210}Pb. Number of motile cells of *P. bahamense* in waters at all stations were determined from samples collected by a Van-Dorn waterbottle. Previous record of bloom occurrences in the bay compiled by the Philippine Bureau of Fisheries were used to correlate with the cyst distribution.

The cysts of the species was widely distributed throughout the bay. It was significantly abundant in the surface sediment of west and east coast. In the vertical cyst distribution maximum abundance was found in deeper sediment accumulated for 15 to 17 years ago at central part of the bay. Relatively few cysts were found in southeast coast. This widespread distribution of the cyst may be caused by the extensive blooming occurred during 1991 and 1993. High cyst abundance in deeper sediment at the central part suggested a species might have occurred there nearly 15 years ago without being detected.

DISTRIBUTION OF RESTING CYSTS OF *Pyrodimium Bahamense* Var. *compressum* IN CANCABATO BAY LAYTE, PHILIPPINES

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Resting cysts and vegetation cells of *Pyrodimium bahamenses* var. *comporessum* were observed in Cancabato Bay, Leyte, central region of the Philippines in July 1994. Top 2 cm sediment samples were collected from 15 stations using a light weight core sampler. Systs were cleaned using a sonicator and concentrated by seiving technique. Planktonic vegetative cells were taken from 18 stations using Van Dorn water sampler. The water samples were concentrated by gravitation and counted under an inverted light microscope.

Resting cysts were observed at densities from 2.8 to 40.25 cells m^{-3} wherein percentage composition of living cells ranged from 27 to 85 %. The cysts were mostly abundant on the central area of the bay while relatively few cysts were found in the mouth and nearshore areas. It is also in the central area that water discoloration were observed and microscopic analyses showed that vegetative will count ranged from 83.25 to 1025 x 10^3 cells. These suggest that the bloom are mainly generated from the cyst within the bay.

TOXIN ACCUMULATION OF SHELLFISH DURING BLOOM OF *DINOPHYSIS FORTH* AND *D. ACUMINATA* IN JAPAN

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Diarrhetic shellfish poisoning (DSP) is one of the shellfish poisonings caused by dinoflagellates. The causative dinoflagellates are those belonging to the genus *dinophysis*. In Japan, shellfish are known to become toxic when *D. fortii* or *D. acuminata* blooms in the environment. However, it has been pointed out that shellfish often become toxic under absence of these *Dinophysis*. On the contrary, it is also absolved in the southern part of Japan that the toxicity of shellfish does not increase even when these species bloom in high abundance. In the present study, we monitored the amount of DSP toxins, i.e., okadaic acid (OA) and its derivatives, in the shellfish by HPLC, in association with the abundance of *D. fortii* and *D. acuminata*. HPLC analysis (was also carried out on OA and its derivative in the suspended particle fractions in the seawater obtained by successive filtration of the seawater through the plankton nets with mesh sizes of 95, 45, 20 u m, and membrane filters with pore sizes of 5 and 0, 45 u m. The occurrence of OA and its derivatives was confirmed occasionally by ELISA kit for OA. The monitoring survey revealed that the levels of OA and its derivatives in the shellfish increased during the period when *Dinophysis* spp. bloomed in the environment. However, the toxicity of shellfish was not in parallel to the abundance of *Dinophysis* spp. Toxin components were detected in the 20-45 and 45-95 u m particle fractions in which most of *D. acuminata* and *D. fortii* were recovered, respectively. The levels of toxin, however, in these fractions was not in parallel to the cell number of each species in these fractions. The toxicity of the cell calculated from total toxin amount and total cell number in the fractions was low when these species bloomed in high abundance, suggesting hat toxin content of the cell changes in relation to the blooming stage of these species. Toxins were also detected in the 0.45 and 5-20 u m particle fractions in which no *Dinophysis* spp. were observed. Toxins in these fraction were detected not only when *Dinophysis* spp. were observed. Toxins in these fraction were detected not

only when *Dinophysis* spp., bloomed, but also when these species were not observed in the seawater.These facts indicate the occurrence of an unknown organism which produces OA and its derivatives, the size of which is smaller than *Dinophysis* spp. The toxin in the unknown organism seemed not to be involved in shellfish toxicity directly, because the shellfish toxicity was not always increased during the period when the toxins were absolved in the particle fractions containing the organism.

NODULARIA SPUMIGENA: A TOXIC, BLOOM-FORMING CYANOBACTERIUM IN AUSTRALIAN ESTUARIES AND COASTAL INLETS

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Nodularia spumigena Mertens is a toxic, bloom-forming filamentous cyanobacterium which is found in estuarine and other low salinity waters. Blooms were first recorded in Lake Alexandrina, South Australia in 1878 and it is a continuing problem in major Australian estuaries and coastal inlets, affecting water quality, recreation and tourism, and causing human and animal health hazards. Massive blooms develop each summer from benthic resting stages (akinetes) in the Peel-Harvey Estuary in Western Australia, with spasmodic summer blooms in the Gippsland Lakes, Victoria, Orielton Lagoon, Tasmania, and Lake Alexandrina, South Australia, Development phosphates, and stable conditions, *N. spumigena* produces the cyclic pentapeptide toxin, nodularin. Stock deaths due to poisoning have occurred in Australia and the toxins are accumulated by estuarine mussel.Efforts to alleviate *N. spumigena* blooms in the Peel-Harvey Estuary and Orielton Lagoon include control of nutrient input and increased flow and salinity.

PROGRESS REPORT ON UNESCO MONOGRAPH ON HARMFUL MARINE MICROALGAE

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With the creation of Harmful Algal Bloom (HAB) programme by the Intergovernmental Oceanographic Commission (IOC) of UNESCO has arisen the need for a standardization of methods. More importantly, it has become clear that many developing countries have very limited access to outside literature and limited finances to buy books or to travel to overseas conferences. The First Session of the IOC-FAL intergovernmental panel on harmful algal blooms (Paris, 23-25 June 1992) therefore agreed to support the creation and free distribution to developing countries of a Manual on Harmful Marine Microalgae, which compiles widely different information on the taxonomy, toxicology, and epidemiology of harmful algal blooms. Progress during 1992-94 in the preparation of such a manual (edited by G.M. Hallegraeff, D.M. Anderson & A. D. Cembella; involving more than 40 authors; amounting to over 300 pages in reported. We hope to see it published by mid-1995.

PHYTOPLANKTON PIGMENTS AS BIOMARKERS FOR TRACKING PHYTOPLANKTON-DERIVED CARBON COASTAL ENVIRONMENT

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Chlorophylls and carotenoids in suspended matter, sediment and trap materials analyzed by HPLC technique can be used in tracking seasonal phytoplankton carbon settling out of the euphotic zone in certain coastal waters. Major characteristic phytoplankton carotenoids collected in the traps can reflect sinking phytoplankton composition and degradation processes through the water column and trap compartments. Ratios of chlorophyll a to carotenoids were used to estimate the percentage of different algal classes contribution to settling phytoplankton-derived particulate organic carbon. Overall differential degradation of individual pigments indicate structural stability of the pigment and prevailing biogeochemical processed in the coastal environment. The formation of a compound called loliolide has been confirmed and this compound can be potential source of phytoplankton-derived carbon accumulated in coastal sediments.

NUTRIENT FLUX FROM MANGROVES

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Tidal exchange of nutrients between mangrove swamps and adjacent coastal waters was studied for two mangrove ecosystems in southern Thailand during September 1990 and October 1993. Nutrient flux estimate was based on similar studies in temperate salt marshes and indicated the export of nutrients and sediment during both wet and dry seasons. Fluxes were higher for mangrove forest at Phang-nga Bay as compared to that of Ban Don Bay. These observations suggest the importance of mangrove forests in contributing nutrients into the coastal zone, which acts as a source of enrichment for the marine environment.

STUDY ON PLANKTON PRODUCTIVITY AT MANGROVE AND ITS SURROUNDING WATERS IN KAO BAY, NORTH MOLUCCAS

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From four times of observation at different areas in Kao Bay (North Moluccas), the chlorophyll a contents seem to be high around mangrove water than is surrounding waters. The high concentration of dinoflagellates increases the chlorophyll-a contents in surrounding waters. Results suggest that plankton productivity plays important role and supports the life of small pelagic fishes in Kao Bay, North Moluccas.

SOME ASPECTS ABOUT BIOGEOCHEMICAL PROCESSES OF SULFUR AND ITS EFFECTS ON THE MANGROVE ECOSYSTEM IN THE NORTH OF VIETNAM

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There are about 65,000 ha mangrove in the North of Vietnam from Mongcai to Lachtruong. In this coastal zone, the mangrove ecosystem has very high production and biodiversity. The biogeochemical processed of sulfur is one of the most important processes in the mangrove ecosystem. The sulfur is concentrated with high content in the mangrove sediment by sulfat reducing bacteria which live upon decomposing organic matter of mangrove. Prom Mongcai to Doson, the total sulfur content of mangrove sediments is about 1.5-3.5 percent and from Doson to Lachtruong it is lower 1.5 percent. The sulfur forms have been determined as SO_4, H_2S, FeS, S^o, FeS_2, S org. and they have changed into FeS_2 (pyrite) in the early diagenes processes. The degree of pyritization is about 25-75 percent in surface layer and 50-98 percent in lower one. Pyrite appeared in the micro crystal form lying in the mangrove remains.

At present, there are about 50 percent natural mangrove areas that have been exploited for the agricultureal reclamation, brackish aquaculture and wood. Therefore, the mangrove sediments have been impacted and changed by the biogeochemical processes as following :

Oxidation and sulfatization have made the acid and salt soil, rich in free ions as H^+, AL^{3+}, SO_4^{2-}, Fe^{2+}, Fe^{3+} and degraded the agricultural reclaimed areas. The oxidation has made the mangrove sediments in the brackish water pools and tidal flats rich in the oxides and hydroxides of Fe and Mn and firm in the bottom. Therefore, the production of aquaculture and biodiversity of mangroves have been reduced. Highly reducing has made the aquacultural environment poor in O_2, rich in H_2S and the pollution of H_2S has reduced the biological resources and biodiversity. On the base of the research in Biogeochemical processes of sulfur, the methods for rational utilization and rehabilitation of mangrove ecosystem in the north of Vietnam have been proposed.

BIOGEOCHEMISTRY OR TROPICAL MANGROVE SOILS RECENT ADVANCES AND IMPLICATIONS FOR MANAGEMENT

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Notable advancements over the past 5 years have been made on the biogeochemistry of tropical mangrove sediments in northern Australia, Asia and Papua New Guinea. Pathways of anaerobic microbial activity and nutrient cycling have been deduced in several mangrove forests of the wet tropics and in arid regions. These results indicate: rapid rates of microbes, but are rarely sulfidic; and decomposition pathways may be dominated by suboxic processes, particularly iron and manganese reduction. Anthropogenic inputs into mangrove forests may severely disrupt these pathways of sufficient nutrients for sustainable mangrove plant growth. Physical and/or chemical disruption of mangrove soils may lead to a wide range of problems that can have important implications for sustainable development, conservation and management of tropical mangrove forests.

IMPACT OF HUMAN POPULATION ON MANGROVE AND LANDUSE CHANGE AT BAN DON BAY, SURAT THANI PROVINCE, ON THE EAST COAST OF SOUTHERN THAILAND

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Mangrove forest area, inland forest area and other landuse areas at the Ban Don Bay, in Surat Thani Province, on the east coast of Southern Peninsula, Thailand were detected from multidated Landsat satellite CCT data. The landuse data were classified into 13 types from topographic map in 1973, from landsat-4-MSS on 12 April 1984 and from Landsat-5-TM on 28 March 1993. The results showed that the forest and mangrove areas have been decreasing from 1973 to 1993. The mangrove area covered 4.68% in 1973, 2.54% in 1984 and 2.16% in 1993. At the same time, the agricultural land areas such as the paddy field, orchard, garden, rubber and oil palm plantations are expanding, especially the shrimp pond areas. From the survey statistics of the whole land area of Surat Thani Province, the areas of existing forest from 1961-1991 and the areas of mangrove forest 1975-1992 have been diminishing at the alarming rate. Ploting of the area of existing forest and population of Surat Thani showed very high correlation. This is also true with the correlation of the areas of mangrove forest and shrimp farm is Surat Thani. This means that the deforestation problem and economical problems are the main cause of landuse changes in Surat Thani.

PICHAVARAM MANGROVE ECOSYSTEM - HUMAN IMPACT AND MANAGEMENT

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Pichavaram mangrove, covering an area of over 110 hectares are situated along the southeastern coast of India (Lat. 11° 26'N; Long. 79° 48'E). They are surrounded by 11 villages inhabiting about 1700 families and this ecosystem have been subjected to human intervention from the very early days. People inhabiting in these region are either directly or indirectly causing significant damage to mangrove ecosystem without knowing is real biological importance. Nowadays Pichavaram mangroves are severely disturbed by some anthropogenic effects such as tourism, fishing, aquaculture, pouching, sewage disposal, human settlement and film industry. Various government organizations and research institutions are involved in the management of this fragile ecosystem. This paper also described the intensity of damage caused by human activities, socioeconomic aspects, anagement strategies and possible conservation measures to protect the Pichavaram mangroves from further destruction.

IN-SITU MEASUREMENTS OF NUTRIENTS IN THE GULF OF THAILAND

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The increased concern for the marine environment has made Thailand start establishing a marine surveillance and information system, the so-called SEAWATCH Thailand programme. This system is designed and under implementation with monitoring and forecasting as main objectives. The system include a network of environmental data collection buoys, transmitting in-situ observations in near real time. The sensors attached are state-of-the-art sensors which can operate mounted on remote oceanographic buoys. These sensors include traditional physical sensors and newly developed chemical and biological sensors.

This paper results from in-situ measurements of nutrients. Such data may prove most valuable when evaluating and forecasting the conditions related to among others algal blooms and discharges of pollutants. Using these data and other data from the SEAWATCH system, the responsible agencies for managing the Thai marine environment can make their decisions based on knowledge rather than assumptions and thereby securing a sound and healthy marine environment which will serve the various users.

INPUT FROM THE CHAO PHRAYA AND THE BANG PAKONG RIVERS INTO THE GULF OF THAILAND

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The Chao Phraya, the largest river of Thailand, was studied for its input into the Upper Gulf of Thailand. A comparison with the Bang Pakong River which is situated in a less urbanized and less industrialized area was made. Although concentrations of nutrients in the Chao Phraya Estuary were much higher than those in the Bang Pakong Estuary but no difference was found for the concentrations of trace metals. However, a significant higher concentration of trace metals in the Chao Phraya sediments were observed.

WATER POLLUTION IN THE MEKONG AND RED RIVER MOUTH AREAS

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In the paper, the main results obtained in the frame work of the Project No. 7 "Coastal pollution transported by river flows" in the national Program for marine Research. 1992-1996 will be presented. The study has been conducted for the most important river mouth areas in Vietnam from the view of pollution. Among them there are the estuaries of the Red and Mekong Rivers.

The boundaries of the above mentioned rivers plumes under various climate conditions are determined by composition of mathematical modeling and remote sensing methods.The water sampling and chemical analysis have been provided for the flood and dry seasons. Gross fluxes and concentration of heavy metals (Cu, Pb, Cd, Ni, As, Hg), nutrient (PO_4, NO_3, NO_2 ,NH_3) and organic chlorines (DDT, 666) will be described. Afterwards primary conclusion on the water quality of these areas will be made.

NUTRIENT INPUTS FROM THE MAJOR RIVER TRIBUTARIES OF THE NATIONAL CAPITAL REGION (NCR) TO MANILA BAY

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The study on nutrient inputs from the major river tributaries of NCR to Manila Bay is primarily important due to its impact on the productivity of the primary producers of the marine ecosystems.

The rapid expansion of economic and social activities coupled with population growth in the catchment areas of the rivers and the coastal area of the bay had tremendously accelerated the degradation of its water quality and natural resources.

The major rivers of the metropolis discharging into manila Bay include the Pasig/Napindan River, Navotas, Malabon, Tullahan, Tenejeros Rivers (NMTT), San Juan River, Marikina River and Paranaque River. All of these rivers are presently polluted heavily and exhibit high ranges of biochemical oxygen demand (BOD). Past data on BOD showed that the Pasig/Marikina River has 3-10 mg/l. Paranaque River, 25-44 mg/l, Tullahan-Tenejeros River, 30-190 mg/l.

Data on nutrient concentrations from most of these river systems were quite inadequate. Previous study on nutrients concentrations of Pasing River conducted by the same researcher revealed high annual mean concentration of ammonia 0.868 mg/l, total phosphate, 0.66 mg/l and orthophosphate, 0.93 mg/l.

Initial findings indicated low water quality at the river boundaries and approximately 300 to 500 meters from the river mouth in terms of dissolved oxygen (DO) range 0.6-6.9 mg/l, nitrate< 0.002-0.008 mg/l, orthophosphate 0.11-0.45 mg/l.

STUDY ON POLLUTION OF JIAOZHOU BAY

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Based on the long-term development and prosperous of its economy, this paper inquires into the pollution of Jiaozhou Bay which is situated in the middle part of Yellow Sea of Western Pacific. Through the systematic sampling and analysis to the surface layer of deposits in the Jiaozhou Bay, the author obtained the content of the heavy metal elements such as mercury (Hg), copper (Cu), lead (Pb), chromium (Cr), zinc (Zn) in it and the present distributing situation of substrate pollution caused by them in Jiaozhou Bay. And starting from the control to the source of pollution, investigation, monitoring and theoritical research of pollution, it was discussed the necessary, possibility and way of synthetical management.

MARINE POLLUTION MONITORING

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Papua New Guinea is a developing nation and depends solely on its natural resources. With current major resource developments from mining, forestry and petroleum, the natural environment including water resources of the country is under tremendous threat. The report will highlight the mining impacts to the marine environment in the country.

All mining operations in the country dispose off their waste soft-rock and tailings into water sources both riverine system and ocean. This led to deviation in the marine and aquatic ecosystems. The Papua New Guinea Bureau of Water Resources is currently planning on how to monitor the Gulf of Papua in terms of its water quality with assistance from the Department of Environment and Conservation. The Department of Fisheries is monitoring fish types in various areas of this marine system but most monitoring is done by the Ok Tedi Mining Limited Environment Division, who operates the giant mining operation in the head mountains of the watershed that discharges into the Gulf of Papua. An Environmental monitoring Committee was established between Papua New Guinea and Australian governments to monitor the use of the marine environment in the Torres Straits which is next to the Gulf of Papua under a bilateral agreement.

The available data is not enough to conclude the extent of the pollution in the marine ecosystem and water quality but is reliable enough to assist the governments to put in place some management criteria to prevent further destruction to the marine environment. All respective organizations are working together, both locally and internationally to put ideas together to initiate working, management and conservation programmes to be used in the marine monitoring programmes.

MARINE WATER QUALITY MONITORING

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Marine water quality monitoring is an important aspects of overall marine water quality management. A well planned and well managed marine water quality monitoring system is required to predict changes of trends of changes in the quality of a particular marine waterbody, so that curative of preventive measures can be taken to restore and maintain ecological balance in the waterbody. Monitoring is needed to ensure that standards and criteria set by the regulatory agencies are met for the protection of marine water quality.

In attempting to evaluate problems of marine pollution and to take remedial measures to reduce and eventually eliminate its menace, both policy-makers, administrators, and regulatory bodies are faced with a critical lack of adequate information to effect policy decisions and recommendations. The state of the marine environments is relatively unknown, this being particularly the case in the East Asian Seas. It is therefore very important to establish a surveillance and monitoring system with clearly defined objectives to establish marine water quality criteria applicable to the specific conditions existing in the country. Such a system is required for the proper protection and use of living marine resources and to give conviction and weight to marine water quality

management considerations that are important in the formulation of national policy. This marine programme should provide a clear picture of what the present state of marine pollution is, what is effects are on various uses of the sea as a resource, including its use and potential as a source of food, and a projection of what such effects may be in the future if not controlled and allowed to continue unabated.

In this paper, the authors, from their personal experience delineate the salient features of the monitoring of the marine water quality in the East Asian Seas region in order to control the marine pollution for the protection of marine resources and marine water quality for other uses.

A MEASURE TO PREVENT THE PROGRESS OF ORGANIC POLLUTION ON THE SEA BED JUST BELOW THE FISH NET PENS WITH BIOLOGICAL ACTIVITIES OF A POLYCHAETE, *CAPITELLA* SP. 1.

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Over the past three decades, fish farming using net pens has been developed in the coastal areas throughout Japan. Recently, however, many fish farms have suffered from organic pollution of the water and bottom sediment, due to large amounts of organic waste from the fish farms themselves. The organic pollution tends to cause depletion of dissolved oxygen in the bottom water and production of high levels of hydrogen sulfide in the sediment in summer. Such anoxic condition in bottom environment result in catastrophic environmental disturbance to the benthic communities and deterioration of rearing conditions of the fish farms.

In the past four years, we have attempted to reduce the organic pollution of the bottom sediment by biological treatment. In the organically polluted areas throughout the world, thread-like small deposit feeding polychaetes *Capitella* species often densely occur. In our study areas in southern Japan, *Capitella* sp. recolonize the organically polluted areas just below the fish farms from late autumn to spring, when relatively oxidative conditions are formed in the bottom environment. This species has very unique life history characteristics as very short life cycle for 4 to 6 weeks, extraordinarily large potential for population growth, and year-round reproduction as population over the densities of approximately 37,000 individuals per square meter has enough potentials to decompose the organic matter loaded on the bottom sediment just below the fish net pens and prevents the generation of high levels of hydrogen sulfide by the activities of sulfate reducing bacteria in the sediment.

The natural population of *Capitella* is also suffered from the marked decline of population size, due to the occurrence of highly reduced conditions in the sediment during the summer. Therefore, the impacts of biological activities of this polychaete on the chemical conditions of the sediment appear only in the limited period of the year (from winter to early spring). Fortunately, it is easy to create the dense colonies of *Capitella* in the laboratory.

We are planning to establish the dense patches of *Capitella* on the organically polluted sediment just below the fish net pens with the cultured laboratory colonies to treat the polluted sediment quickly. We will introduce the detail of this plan to treat the organically polluted sediment and discuss its application to the fish farm.

ATMOSPHERIC VERSUS RIVERINE INPUT OF NUTRIENT ELEMENTS TO THE NORTH WEST PACIFIC COASTAL OCEANS

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Concentration and distributions of nutrient elements (N, P, Si) were examined based on the data from some large Chinese estuaries and meteorological stations. Riverine concentrations are much higher than those from large and less disturbed world system but similar to the European polluted and/or eutrophic rivers. The active distributions in most of the Chinese estuaries provides the apparent concentrations of nutrient elements that is 200% to one order of magnitude those observed in the river. With respect to the atmospheric wet depositions concentrations of nutrient elements are highly variable depending on the element and source/trajectory of airmasses. The comparison with riverine depositions reveals that atmospheric input may have significant impact upon the primary production in coastal oceans. Also, a positive correlation between atmospheric nutrient inputs and harmful plankton blooms has been observed.

INFLUENCE OF THE ITCZ ON THE FLOW OF THERMOCLINE WATER FROM THE SUBTROPICAL TO THE EQUATORIAL PACIFIC OCEAN

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The flow of thermocline water from the subtropical to the equatorial Pacific Ocean is investigated using a 2 1/2-layer numerical model. In this system, the lower of the two active layers represents the thermocline region including the mixed layer. Water is allowed to move between layers via an across-interface velocity, which parameterizes the processes of entrainment and subtropics subduction. Solutions are obtained in a basin with zonal boundaries like those of the Pacific Ocean, but it extends meridionally only from 35S to 35N. Solutions are forced by Hellerman and Rosenstein (1983) winds. Our primary result is that the presence of the Intertropical Convergence Zone (ITCZ) inhibits the direct flow of lower-layer (thermocline) water from the North Pacific to the equator. Lower-layer water must first flow to the western boundary north of the ITCZ, and only then can it move equatorwark in a wastern-boundary current to join the Equatorial Undercurrent (EUC). This constraint is a strong one that is a direct consequence of potential-vorticity conservation in the lower layer.

Another property of our solutions is that lower-layer water converges on the EUC in the central Pacific from both sides of the equator. However, this convergence is not fundamental part of the major circulation cells that carry subtropical water to the equator the North and South Subtropical Cells). Rather, it is associated with a pair of tropical recirculations that are confined within 5 degrees of the equator.

LARGE-SCALE TRANSPORT OF CHEMICAL ELEMENTS IN AEROSOLS OVER THE EAST COAST OF ASIA

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The long-rang transport of aerosol from continents affects the marine atmosphere and oceans. Marine aerosols from the Asian continent are significant source for the non-biogenic deep-sea sediments in the North Pacific. With this atmospheric transport, pollution aerosol is also expected to be carried from the east coast region of Asia to the western and the central North Pacific.

In order to characterize this transport and its effect to the global environment, we have collected the aerosol samples concurrently from Sapporo (43.1°N, 141.3°E), Japan and Vladivostok (43.1°N, 131.9°E), Russia since the fall of 1989.

To get a first insight into the data factor analysis was applied. It has been obtained that mineral dust is a common factor majority of elements over Vladivostok and Sapporo. Local element sources in Vladivostok's atmosphere do not influence element concentrations over Sapporo.

THE INFLUENCE OF MARINE ENVIRONMENT ON THE INPUTS OF NUTRIENTS AND TRACE ELEMENTS THROUGH 'WET' AND 'DRY' DEPOSITION: A REMOTE ISLAND SITE INVESTIGATION IN THE SOUTH PACIFIC

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Field measurements are being carried out in Suva, Fiji, a relatively clean remote island site at Latitude 18°09'S, Longitude 178°27'E, Height 6 meters, to provide data on the deposition from the atmosphere of a range of chemical species. This joint project between the CSIRO DAR group, Australia and the scientists at the University of the South Pacific, Fiji, is expected to generate valuable information on 'wet' and 'dry' precipitation chemistry which may bear important clues to air-sea interactions over Fiji.

Samples were collected on a fortnightly basis and were analyzed by CSIRO DAR at Aspindale for pH, Na^+, K^+, Mg^{2+}, NH_4^+, Cl^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, methane sulphonic acid, oxalix acid, formic acid and acetic. Suva being a maritime site, away from any source of industrial pollution, it is envisaged that the influence of ocean would be high. Therefore we have analyzed our data to establish the magnitude of nss and oceanic contributions to the complete suite of the major ionic species determined in this study and have found that significant proportions of SO_4^{2-}, Ca^{2+} and K^+ are derived from sources other than the ocean whereas most of the Mg^{2+} comes from the ocean.

The data is also being used to test the hypothesis that marine phytoplankton might control the cloud condensation nuclei (CCN) population which in turn control the cloud albedo and hence the global climate; CCN are composed mostly of ammonium sulphate believed to be produced by

the atmospheric oxidation of dimethyl sulphide (DMS) emitted by phytoplankton. The coherence between seasonal cycles of DMS, methane sulphonate and sulphate in our marine air will be compared with similar studies by Ayers *et al.* Cape Grim, Tasmania.

This paper present results of our work over the last eighteen months.

WET DEPOSITION OF ATMOSPHERIC PLANT MAJOR INORGANIC NUTRIENTS AT THE MID WESTERN COAST OF KOREAN PENINSULA

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The concentrations of major plant inorganic nutrients of ammonia, nitrate, phosphate and silicic acid have been determined at the midwestern coast of Korean Peninsula (Korea Ocean Research and Development Institute, 37°N, 126° 50'E) since January 1992 to December 1993. Rain samples is taken by placing an acid cleaned funnel and snow samples is taken by collecting fresh snow. Sampling is done on each precipitation event in order to minimize the contamination in the sampling, handling and storage.

In general, high contents of N-, P-, Si-nutrients in the precipitation were found during summer monsoon, spring, and winter, respectively. The contents of $NH4^{+}$, NO_{3}-, PO_4^{3} -, and $Si(OH)_4$ in the precipitation vary from 1.62-348, 1.06 to 47.92, 0.03 to 12.33, and 0.70 to 5.20 umol l^{-1} respectively. Annual deposition fluxes of atmospheric $NH4^{+}$, NO_{3}-, PO_4^{3}-, and $Si(OH)_4$, and 0.084, 0.016, 0.0012, and 0.0014 mol m^{-2} yr^{-1} at the coast of midwestern Korean Peninsula. Provenance of precipitation was delineated using oxygen isotopic composition and ^{210}Pb activity of the precipitation.

The total annual atmospheric transport of plant major inorganic nutrients in wet precipitation to the Yellow Sea was extrapolated using more than a year-long monitoring of precipitation and provenance of the precipitation. They may reach up to 38.22, 7.28, 0.55 and 0.64x109 mol yr^{-1} for $NH4^{+}$, NO_{3}-, PO_4^{3}-, and $Si(OH)_4$, respectively. The atmospheric supply of ammonia and phosphate may exceed the riverine input over the Yellow Sea.

SEWAGE OUTFALL AND SEDIMENT SILTATION

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Shenjiamen port, where could be moored about 5000 fishing boats, is the most important fishing port in China.This port plays an essential role in Chinese fishery industry. Unfortunately, serious siltation obstructs the port development. It is necessary to dredge the channel for keeping the port navigable. The dredging plan must be made upon the understanding of the cause of the siltation. Usually someone thinks it is caused by hydrodynamic condition which may be the main cause for other ports but not for this one. It is difficult to explain the distribution of the siltation area there by the hydrodynamic condition.

The port area stretches 2 km with about 300 m wide and less than 5 m deep. There are 3 outfalls of waste water along the bank. These outfalls are controlled with tidal phase. It is closed

during flood period and opened after the beginning of falling tide. The waste water run out forming a black water area with strong plume where the gradient of salinity is about 1.0\m. There are much flocs inside the plume, the waste water area, where the most serious siltation take place. This suggests that the organic materials make the fine sediment flocculate and speed the settling velocity which cause the siltation of sediment. The hydrodynamic condition could be one of the cause of siltation but not the main one, while the biogeochemical condition could become the main cause of siltation in some cases.

ATTITUDE OF THE RESIDENTS ALONG THE RIVER BANKS AND MANILA BAY COASTAL AREA TOWARDS THE RIVER REVIVAL PROJECT

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The Navotas-Malabon-Tinajeros-Tullahan (NMTT) river system is a 26-kilometer waterway that runs from La Mesa Dam in Novaliches emptying westward towards Manila Bay. The river system greatly contributed to the degradation of Manila Bay due to pollution from domestic and industrial sources. A UNEP study in 1986 revealed that the domestic source contributed 70% percent of the pollution load. To solve the problem, the Department of Environment and Natural Resources in 1989 implemented the river revival project. Hence, an attitudinal study on the residents along the area and near the Manila Bay had been conducted since they are the ones who are directly affected by the condition of the river and the Manila Bay. The study was conducted to 350 residents along the river banks and Manila Bay to determine their attitude based on affective, cognitude and behavioral domain. It was also implemented in order to formulate recommendation/sollutions for the rehabilitation of the river.

Findings of the study revealed that most of the respondents have stayed in the area for along period and wer mostly in the peak of their working years. Transfer to the area was because of marriage, employment and availability of area to squat. Majority disposed their solid, liquid and human wastes direct to the river and bay because of the absence of sanitation facilities .On the aspect of livelihood, many of the respondents were fishermen, vendors and small business owners. Their average monthly income was below the poverty threshold. Almost one half of the sample had no knowledge about the project because of limited information dissemination. However, it is notable that many of the respondents could be systematically mobilized for an effective information campaign.

As to their overall attitude, a great majority had favorable attitude towards the project which means they are willing to some form of interventions that the government will introduce to rehabilitate the river. Recommen-dations/solution were also elicited from the respondents for the improvement and appropriate implementation of the project. Based on the results of correlation analysis of some socio-demographic variables and overall attitude, it revealed that education, age and length of stay in the area exert influence to the level of attitude.

XENOBIOTICALLY ACTIVE INDUSTRIAL PRODUCTS IN THE COASTAL AND MARINE ENVIRONMENT

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Many commonly used industrial products and/or their common breakdown products act as xenobiotic (articifial) hormones in humans, primates, rats, birds, fish and other wildlife. Xenobiotics may be relatively inactive but may have a profound influence if, for instance, a developing organism is exposed for a short period during a particular developmental stage, lasting only a few days or weeks. Other xenobiotics may be more active. Such exposures may lead to long-term physiological and/or psychosexual abnormalities that may not manifest for several decades after birth in humans.

a. feminization or male aligators in the Florida Everglades.
b. masculinization of female fish.
c. feminization of male fish.
d. sensitivity to halogenated aromatics in Great Lakes salmon.

Observation show that many wild and qultured populations of commercially imported species have been impacted.

Effects reported in human include :

e. sexual abnormalities in males
f. increasing incidence of prostate cancers
g. psychosomatic disturbances in older people

Xenobiotics that may act as 'artificial hormones', and which may occur in the environment include:

1. alkyl-ethoxalates, produced as break-down products of various surfactants, commonly used in detergents; the nonyl form is banned in the UK and in many other parts of the European Unio
2. PCBs and many other break-down products of pesticides
3. tributyl tin (TBT)
4. many others.

PCBs are particularly important for marine scientists as only 1% total PCB production has yet entered marine ecosystems.

The paper presents more details, listing xenobiotically active compounds, and alerts Indonesian scientists and administrators to possible long term, avoidable consequences of industrialization, compounds, and alerts Indonesia scientists and administrators to possible long-term, avoidable consequences of industrialization.

POLYAROMATIC HYDROCARBON IDENTIFICATION IN SURFICIAL SEDIMENT OF LANGNGA COASTAL AREA, SULAWESI

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Langnga coastal area is very sensitive to oil pollution caused by tanker traffic along Makassar strait. Seasonal black and muddy seawaters found regularly in this coastline where artisanal fishermen live.

An investigation on polyaromatic hydrocarbons (PAH) in the surficial sediments has carried out in 1992-1993 using synchronized spectrofluorometric and microgravimetric methods. The results showed that aromatic types in the sediments are essentially in the forms of; alkyl benzene, fluoranthene, naphtalene, penanthrene, pyrene, benzopyrene 3, 4 and perylene. he range of concentrations is as follows (in mg kg dry weight of sediment): extractable organic matters is between 179.99 and 761.60; total hydrocarbons is 116.24 and 396.61 and aromatic fraction is 50.23 and 171.06.

The PAH content represents in average 45 percents of total hydrocarbons. It can be concluded that the sediment environment has been chornically polluted by crude oils or its products and the accumulation of aromatic compounds may deteriorate the quality of life local community. No other PAH source was found in this coastal area.

POLLUTION STATUS OF AQUACULTURE AREAS BY ASSESSING THE SEDIMENTARY NON RESIDUAL TRACE METAL CONCENTRATIONS

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Mudflats along the western coast of Peninsular Malaysia are commercially used for the semiculture of the marine bivalve, *Anadara granosa.* However, very little information is available on the status of trace metal levels in sediments from these areas. Therefore, the total sedimentary non-residual concentrations of Cd, Cu, Ni, Pb and Zn from these areas were determined by employing the rapid, inexpressive, preferential leaching of from these metals with 0.5 M hydrochloric acid. This approach appears to be useful to assess the impact of trace metal pollution in sediments particularly from anthropogenic inputs. Sediments from these aquaculture areas were therefore, considered to be polluted with a particular trace metal when the concentration exceeds the statistical parameter of *TMbaseline* + 2s where TM and s are the mean concentration and the standard deviation of a particular trace metal in the reference sediments respectively. The reference sediments were collected from the mudflats assumed to receive a minimal impact of trace metal pollution particularly of anthropogenic origins. The relative impact of trace metal pollution between various aquaculture areas is then computed present investigation appears to be potentially rewarding especially in providing environmentally useful information on the degree of trace metal pollution in sediments from the aquaculture areas of Malaysia.

INVESTIGATION OF HEAVY METALS IN THE MAJOR RIVER TRIBUTARIES OF MANILA BAY

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Chemical characteristics of coastal water undergo changes when it mixes with inflow of wastewaters from industries. Industrial outfalls discharge to rivers are heavily loaded with metals, organo chlorines and biodegradable organic substances. These may be available for uptake and bioaccumulation by bottom sediments which may accumulate in living resources to levels considered unacceptable for human consumption. The uptake of heavy metals by certain species provides a way of monitoring the presence of such polluting substances. Consequently, estuarine sediments accumulate many substances carried toward the sea by rivers. Inflow of major rivers namely Pasig, Marikina, San Juan, Pasranaque and Tenejeros with heavy metals to Manila bay may reach undesirable levels through bioaccumulation on fisher and shellfish which require monitoring.

Since protecting the coastal environment is one of the major concerns of the Department of Environment and Natural Resources, it is of great importance to assess the present heavy metals concentrations in major rivers flowing into Manila Bay. This will provide an information to evaluate the productive potential of Manila Bay for livelihood opportunities.

The objectives of the study are to determine the concentrations of mercury, cadmium, lead and zinc in water sediment samples of major rivers affecting Manila Bay and to determine the difference in concentrations of the above metals in water and sediment samples during dry and wet seasons.

USE OF BIVALVES FOR POLLUTION MONITORING IN SOUTH COAST WATERS OF P.R. CHINA

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The china's "Bivalve Monitoring" program was carried out during 1991-1992 as a preliminary monitoring program to assess the status of chemical pollution of P.R. China coast, and the possible hazards to human health through the consumption of seafoods. The monitoring program of south coast zone was completed by Third Institute of Oceanography.

Oysters (*Crassostrea gigas, Saccostrea cucullata*), mussels (*Perna viridis*)and other bivalves were collected from the south coast of China, and the analyses for trace metals (Hg, Cu, Zn, Pb, Cd, Cr and As), organochlorines, 666, DDT) and petroleum was completed at Third Institute of Oceanography, SOA. During the lead-in period of the program, we participated in intercomparison analyses, and at intervals throughout the program, standard substances and blanks were analysed.

Monitoring results suggested that there is no evidence in oysters data for local elevated concentration of Hg, Pb, Cr, and As, and the concentration of Cu, Cd, and Zn in oyster from Zhuhai coast and petroleum in clams from Changjiang estuary appear obviously highest values, which may be influenced by industrial sewage discharge. <666 and <DDT content in oysters decreased by about one order of magnitude as compared with 10 years ago, which have been related to stop production of pesticides (666, DDT) in China. It was observed that <DDT concentration in the most bivalve samples was higher than that of <666. In the paper, food sanitation quality of the bivalves in the survey area was also discussed.

HEAVY METALS IN BIVALVE OF CHINESE COASTAL ZONES

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The use of marine organisms, especially bivalves, to record in their soft tissues measures of pollutant concentrations in the waters in which they live is the basis for "Mussel Watch" program. Because bivalves (mussels and oysters) greatly concentrate many toxins from seawater, making analysis easier, and at the same time they integrate pollutant levels over time, thereby giving a true indication of pollutant status when sampling can only be conducted monthly or yearly. So the soft tissue of bivalves are taken as indications of heavy metals concentrations in the environmental waters.

Mussels, oysters, clams, scallops and so on, collected along the Chinese coastal zones (Yellow Sea, Bohai, East China Sea, South China Sea), have been analyzed for 8 heavy metals (Cu, Pb, Zn Mn, Fe, Co, Ni, Cr) with atomic absorption spectrophotometry since 1993. From this we can know the levels of heavy metals along the Chinese coastal zones. In Jiaozhou bay of Yellow Sea, we've collected mussels, whelks and water samples for analyzing the transferring of heavy metals in food chain.

HEAVY METALS IN SEDIMENTS AND BIOLOGICAL SAMPLES FROM WEST COAST OF PENINSULAR MALASIA

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The west coast of Peninsular Malaysia is exposed to several sources of pollutant, predominantly from human activities. In this study, heavy metals were measured in sediments and biological samples such as fishes, crabs and prawn collected along the coastline or from several parts of the west coast of peninsular.The results show that in general the background levels of heavy metals in sediment and biological samples from most of the sampling locations are still within the normal levels found elsewhere. The levels of heavy metal in the majority of the sediment samples are between 600-900 ug/g for Zn; 10-30 ug/g for Pb; less than 5 ug/g for Cu and less than 1 ug/g for Cd. The levels of heavy metals in biological samples such as crabs are within the range of 2-12 ug/g for Pb, less than 2 ug/g for Cd, 7-45 ug/g for Cu and 10-46 ug/g for Zn. Heavy metals in fishes range from 0.4-2.5 ug/g for Cu, 0.5-2.0 ug/g for Pb, 6-23 ug/g for Zn less than 0.2 ug/g for Cd. Copper content in prawns are less than 4 ug/g, while Pb less than 5 ug/g, less than 12 ug/g for Zn and less than 1 ug/g for Cd. The above information is justified in view of expected increases in industrial, domestic and municipal effluent discharges as the country makes headways into diversified land based development, especially in the industrial sector. The anthropogenic input of heavy metals into coastal environment of Peninsular Malaysia had not been adequately studied, however, there are valid reasons to suspect enrichments of heavy metals into the coastal environment.

THE DETERMINATION OF HEAVY METALS IN SEAGRASS (*PORTERASIA COARCTATA* TAKEOKA) AS A POTENTIAL BIOLOGICAL MONITOR IN DELTAIC SUNDARBANS, NORTHEAST COAST OF INDIA

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Seagrasses serve as heavy metal reservoirs and are important in the biogeochemical cycles of coastal and estuary areas. The present paper deals with Fe, cu, Mn, Zn, Co, Ni, Cd and As levels in marine phanerogam *Proterasia coarctata* Takeoka, sampled from salt marsh sediments of detaid Sunderbans at the confluence of Bay of Bengal. This area is of particular interest because of the non-treated waste water discharge from petrochemical and metallurgical industries along with seven anthropogenic stresses. The study aims to collect baseline data for future environmental monitoring programme and to establish the distribution of some metals in the seagrass tissue which could serve as indices of pollution.

The seasonal variation in concentration of eight metals in the seagrass and surficial sediment was studied. The sedimentary metal concentration were reflected in the plant tissue (root, leaf and rhizome). An overall common trend was revealed with the following decreasing order: Fe> Zn> Mn> Cu> Cd> As> Co = Ni. Fe, Zn, Cu and Mn showed considerable variations in their concentration in the above-and below-ground tissues of this saltmarsh plant. Concentration of Cd and As was registered in traceable amount in few cases whereas level of Co and Ni was below the spectrographic detection limit throughout the study period.

The above- and below-ground tissues revealed that roots presented higher accumulation of Fe in relation to rhizome. This may be due to the greater surface area per unit of weight of the roots. Leaves accumulated more Mn and to some extend Zn in comparison with the rhizome and roots. Cu remained fairly constant throughout the study period in all the tissues which revealed that internal concentration of this element is metabolically controlled within a certain range of values.

The distribution and translocation of metals among the tissues is discussed as well as the role of this plant as indicator of pollution in relation to the degree of accumulation of metals.

ACUTE TOXICITY OF CADMIUM AND CHROMIUM TO TROPICAL FISH: MILK FISH (*CHANOS-CHANOS*)

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Comparison study on the acute toxicity of Cadmium and Chromium to tropical fish has been conducted. The static toxicity test were employed to obtain the LC_{50} 96-h. Juveniles milkfish (*C. Chanos*) were exposed to CD in seawater at concentrations of 0.0, 18.0,56.0, 100.0 mg/L and Cr in seawater at concentrations of 0.0,5.0 10.0 20.0 40.0 80.0 ml/L. The result suggest that Chromium to the milkfish. The LC 50 96h value of Cadmium and Chromium to the milkfish were determined

of 39.833 and 33.584 mg/L, respectively. The significance of these data in establishing water-quality criteria for Indonesia is discussed.

THE ACUTE TOXICITY OF CADMIUM TO THE TIGER PRAWN (*PENAEUS MONODON*) AND BANANA PRAWN (*PENAEUS MERGUIENSIS*)

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Two species of penaeid prawn, *Penaeus monodon* (tiger prawn) *P.merguiensis* (banana prawn) were exposed to cadmium in static system at concentrations of 0, 2, 4, 8, 16 and 32 mg/l. The LC 50 (96-h) values for the banana prawn and the tiger prawn were estimated to be 2.13 mg/l and 2.43 mg/l respectively. Thus, there was the indication that banana prawn was more sensitive than the tiger prawn. The application of the accute toxicity data to the water criteria establishment is discussed, more sensitive than the tiger prawn. The LC 50 (96-h) walues of 2.13 mg/l and 2.43 mg/l were estimated for banana prawn and tiger prawn, respectively. The application of the acute toxicity data to the water quality criteria establishment is discussed.

SPECIES COMPOSITION AND DISTRIBUTION OF SEAGRASSES AT KUTA AND GERUPUK BAYS, SOUTHCOAST OF LOMBOK, INDONESIA

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Studies on species composition and distribution of seagrasses at Kuta and Gerupuk Bays were carried out in September and October 1993. Distribution of seagrasses was observed by walking and snorkeling. Mapping of seagrasses was drawn by using a GPS (TRIMBLE ENSIGN). Density and biomass of seagrasses were collected randomly by using an aluminium cylinder of 0.1 m^2 in total area and height 65 cm.

Eleven species of seagrasses were found i.e. *Enhalus acoroides, Cymodocea rotundata, C. serrulata, Halodule pinifolia, Hd. uninervis, Halophila minor, H. ovalis, H. spinulosa, Syringodium isoetifolium, Thalassia hemprichii* and *Thalassodendron ciliatum.* Species composition and distribution of seagrasses at Gerupuk Bay are higher than Kuta Bay. Density of seagrasses varied from 10 to 7120 shoots/m^2, and biomass found between 0.5-5430.2 g DW/m^2. The lowest density was found in *T. hemprichii* (10 shoots/m^2) and the highest was collected from *H.pinifolia* (7120 shoots/m^2). The lowest biomass was recorded form *H. ovalis* (0.5 DW/m^2) and the highest biomass was found from *E. acoroides* (5430.2gDW/m^2). Seagrass beds on the south coast of Lombok which grown by 11 species of seagrasses have the highest species composition compared with the other area in Indonesian coastal waters.

THE 1991 CORAL REEF BLEACHING IN THE ANDAMAN SEA, THAILAND

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Extensive coral reef bleaching occurred during abnormal seawater warming in the 1991 along the Andaman coast of Thailand. Mean sea water temperature was about 1-3 ^{o}C above the normal summer ambient over two and a half months period before the onset of bleaching in late May. The timing of coral reef bleaching and the period of seawater warming were closely correlated at several localities suggesting a causative relationship.General description of the event was achieved by field surveys. An establishment of coral -transect assessment provided some insight into the consequences of the event to coral communities.Conspicuous bleaching were observed among most of the zooxanthellae cnidarian hosts of which 94 taxa were recorded to have bleached. Acroporid corals were among the most susceptible species. By visual estimations, the percentage of living coral bleached ranged between 10% to 70% of living coral on the reefs. Bleaching responses i.e. unbleached, partially bleached and completely bleached, varied among individuals, species, and reef sited, which is suggesting the complex mechanisms governs coral bleaching. Line transect assessment in some reef site showed decreases in several coral community components after the bleaching event. The total living coral cover, number of species, number of colonies, and species diversity markedly decreased. Delayed and longterm responses of the community to bleaching were also discussed.

PATTERNS OF SPATIAL DISTRIBUTION, DIVERSITY AND COVER OF CORALS IN PULAU SERIBU NATIONAL PARK; *IMPLICATIONS FOR THE DESIGN OF CORE CORAL SANCTURIES*

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Indonesia is a Centre of the highest coral diversity. However, the coral reefs are under heavy pressure of intensive use and exploitation. At present, the are 24 marine reserves including five Marine National Parks in Indonesia. In these parks, zoning systems are being planned to regulate compatible uses. Coral sanctuaries are designed to ensue the replenishment of coral reefs in the park safeguarding its functions such as shoreline protection and the resources uses such as fisheries and tourism. Such areas which are protected from human exploitation can act as reservoirs for unprotected areas in the path of prevailing currents where species are depleted by fishing and collecting.

However, current criteria to design such zones do not take into account underlying ecological processes such as life-history strategies of corals which maintain a coral reef ecosystem and which contribute to spatial patterns of adult coral colonies. From a reef conservation perspective, it is crucial to create as many reserves as possible and to made them as large as possible.

However, the feasibility of a management plan strongly depends on the extent to which the objectives for the conservation and management of coral reefs must be made compatible with objectives which are economically viable and socially acceptable.

The focus of this paper is to review the current coral sanctuary zone in Pulau Seribu National Park in the context of recent and historical information on the patterns of distribution, diversity and cover of corals in the Park of Pulau Seribu is a chain of more than 100 low (<4 m above sea level), coral cay islands covering some 108,000 ha and extending 80 km in a northerly direction from Jakarta Bay. It was the first established Marine National Park (1982) and up to date the only marine park with a zoning system.

The occurrence and species composition of reef-building coral have been studies at three sites using the line-transect method at two depths along a gradient of increasing pollution in the Pulau Seribu National Park. Differences in diversity, growth forms, coral cover, and size-frequencies are observed between the three different sites in the park at two depths: of particular interest are those coral species found at all three sites. The results imply that a series of sanctuary zones would be necessary to maintain the coral diversity in the park. Implications for the design of more coral sanctuaries in the park are discussed both in a scientific and management context.

GEOGRAPHIC LOCATION INFLUENCES CORAL COMPOSITION: A COMPARISON BETWEEN BALI AND SULAWESI, INDONESIA

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The Indonesian archipelago is often perceived as supporting the most diverse coral reefs in the world, yet few studies have been conducted in this region. Coral reefs at three sites is southern Bali, Indonesian are described and compared with coral reefs in southwest of Sulawesi, Indonesia. Comparisons are made using acropporidac the most diverse scleractinian (hard) coral family. Reefs in Bali are heavily impacted by oceanic swells whereas reefs in Sulawesi are sheltered. Both geographic locations supported a similar number of *Acropora* and *Montipora* species (Acroporidae), however composition varied, locations only shared - 60% of species. Species found in southern Bali, and not Sulawesi, were typical of exposed outer reef locations on the Great Barrier Reef, Australia. Species found in Sulawesi, and not Bali, were more typical of exposed outer reef locations on the Great Barrier Reef, Australia. Species found in Sulawesi, and not Bali, were more typical of shletered habitats on the Great Barrier Reef. Thus, he physical environment of a geographic location appears to have a strong influence on coral species composition and abundance. This is consistent with resulted from fringing reefs on the Great Barrier Reef.

Since most corals broadcast their gametes, distribution pattern may not be essentially a consequence of inefficient dispersal. Rathor, variation in community composition may be a consequence of selection against some corals after settlement, favouring species adapted to the geographic location. Such affects may be continuous. With anthropogenic disturbances increasing world-wide, especially of fringing reefs, understanding the processes nearshore is essential towards generating policies that will ancliorate these problems. Interpreting disturbances includes understanding regional influences that may over-ride local phenomenon.

CHINA'S MARINE BIODIVERSITY STRATEGY

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One hundred thirty two scientists from Mainland of China, Taiwan and Hongkong studied systematically the species and their distribution for China Seas recorded during 1992-1993, ranging from bacteria to mammals. Around 20276 species are identified (marine species and their distribution in china's seas, 1994. China Ocean Press).

Due to the over-exploration of species, habitat change, pollution, introduction of denizens and global weather change, many species are in danger of their quantity is greatly reduced.

China has taken various actions to protect biodiversity, including protection of oceanic ecosystem. Sponsored by World Bank and UNDP; the People's Republic of China and Republic of Korea have formulated GEF Project- "Sustainability and Protection of the Yellow Sea Largemarine Ecosystem" Project. Which is start in 1995. Project of South China Sea Large Marine Ecosystem (C.K. Sherman, 1991) should be jointly formulated and started by nations and regions bordering South China sea so as to maintain the health of South China sea large marine ecosystem and to protect biodiversity, accordingly to provide sustainable yield of living resources form South China sea.

BEACH EROSION AND NEARSHORE SEDIMENT DYNAMICS AT BANG THAO BAY, PHUKET

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Bang Thao Bay is on the west coast of Phuket facing the Andaman Sea. It has the problem on the beach erosion at the central portion of the coastline, on the contrary the northernmost and southernmost porting do not show any erosional feature. The beach erosion normally is damaging in the southwest monsoon season but accreting during the northeast monsoon season. The study on the causes of erosion showed that the main causes are natural conditions, the minor causes are from human activities. The sediment transport and features with current and wave measurements typically in the northeast and southwest monsoon seasons are analyzed on the beach, surf zone and offshore areas in order to explain the reason for the beacherosion and beach accretion.

CONSERVATION OF THE CORAL SAND IN SANUR AND NUSA DUA BEACHES IN BALI

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Coral beaches are found in some places in Indonesia, two of them are Sanur and Nusa Dua beaches are located in the southeast and central coasts in Bali. These beaches are formed by coral reefs of which the offshore width are varried, being over several hundred meters in maximum. Coral reef beach consist of a coral-sandy beach, reef edge and outer reef. The coral sand beach which consists of white coral sand were produced by crushing coral blocks into coral sand by breaking waves and transported onto the beach. A little part of coral sand transported by breaking waves on the coral reef, is transported back to offshore through the gaps.

The mining of coral blocks in Sanur beach have been done for many years in order to use coral blocks for construction house and block fences and producing quicklime. The total amount of coral blocks mined has not been estimated, but it may be presumed that a great amount of coral blocks have been removed from the coral flats, and they may be affective in the change of reef profile. Coral mining caused the dying of the reef and decreasing of the sources of the coral sand to the beach. Tsuchiya (1978) pointed out that the coral mining affects to increase the shallow water depth on the coral reef so that beach profiles greatly change due to increase in breaker height, and increasing of the longshore sand transport capacity. Increasing of the longshore sand transport combined with the decreasing of the sources of the sediment from the reef flat has been considered as the main caused of the beach erosion in Sanur beach.

In Nusa Dua beach, there exists two main original causes for beach erosion. the first is the lack of longshore sediment transport by the formation of tombolos which were cuspite forelands about ten years ago, but recently are formed so behind Nusa Besar and Kecil islands, and it is one of the natural beach processes. After the formation of tombolos a little rate of longshore sediment transport exist only so that in the downcoast beach erosion takes place due to lack or decrease in sediment sources. And the second is the coral mining resulting in the water depth deep on the coral flat.

It was also well recognized that the locations of coral mining correspond to the beaches being eroded and collapsed. The more the water depth becomes deep due to mining of coral blocks the more the beach erosion takes place severely, and the more the area becomes wide the more the beach erosion takes place widely. Conservation of the coral sand in Sanur and Nusa Dua beaches have been carried out by constructing of the groins in order to decrease the capacity of longshore sand transport and to stop the sand transported to the gap. Accumulation of the sand at updrift of the groins near the gap can be used for the sand nourishment of the eroded beaches. This paper deals with the historical change of the coastline and the performance of the groins which have been constructed.

COASTAL RESOURCES IN WESTERN SAMOA
SAND AND GRAVEL

Talia, L. and Titimea, A.K.
Samoa

Western Samoa with a population of about 160,000 and a land area of about 2580 km^2 depends largely on its coastal resources to meet the rising demand for constructional and recreational purposes. Coastal areas of Western Samoa had been surveyed for sand and gravel deposits and potential sites had been identified in some parts of the country. However, there is also a need for further studies to accommodate environmental problems. In the northern side of Aleipata wharf about 100,000 cubic meters of accessible materials can be mined, 90,000 cubic meters was discovered at Pu'apu'a and 200,000 cubic meters at Saleaula (Lewis et.al. 1989).

Sand and gravel materials are mainly used for constructional purposes. Existing sand and gravel mining operations are at Mulinuu Peninsula and Vaiusu Bay about a kilometer west of Apia. On average approximately 30,000 cubic meters of materials are removed from Mulinuu while 8,000 cubic meters of materials are removed from Vaiusu Bay area per year. Small scale as well as medium scale mining operations exists around the islands and are to be used for beach replenishments as well as constructions.

Alternative sources for coastal derived sand and gravel deposits are yet to be sought. Management of coastal resources depend largely on government as well as community effort to minimize exploitation of natural resources in the coastal as well as surrounding areas.

SOLUTE TRANSPORT WITHIN SEDIMENTS

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In shallow coastal environments, sediments play a critical role in the biochemical cycling of such substances as nutrients and trace metals. The transport rates of chemical species through sediment determine potential storage of release rates of these substances as well as the chemical environment within sediments.

Molecular diffusion of solute through water is slow and is further slowed in pore waters because the diffusing molecules must follow a tortuous path around the sediment grains. In coastal environments where there are waves, currents, or salinity changes, solute transport can occur at rates which far exceed those due to molecular diffusion. These phenomena can induce pressure gradients within the sediments which in turn force water to flow through the sediment pores carrying solute with it.

Waves propagating along the water surface cause fluctuating pressure gradients within sediments. The fluctuation pore water motions which result give rise to transport which has the character of diffusion. Pressure gradients within sediments also result from the interaction between currents and obstructions on the sediment surface such as sediment ripples, stones or benthic organisms. Another physical mechanism for solute transport through sediments is convection which occurs when the water above the bottom is more saline and therefore denser than and water within the sediment pores.

Burrowing macrobenthos can greatly increase solute transport rates through sediments. The feeding, excremental, and burrowing activities of these organisms can move sediments and interstitial fluids vertically and laterally. Established burrows act as coduits for water flow through the sediment allowing for enhanced solute exchange. Such flows can be driven by pressure gradients induced by waves or by currents of they may be due to respiratory pumping by the animals living the burrows.

HYDRONUMERICAL MODELLING OF TYPHOON SURGE ALONG THE BEACH OF VIETNAM

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Typhoon surge is one of the most dangerous natural phenomena in Vietnam. In this report the main aspects of its hydronumerical modelling will be presented. The nonliniar shallow water equation system is used.

The first part is provided for description of full typhoon wind model (which allows us to avoid the unrealistic going down of the sea water lave on the left side of the typhoon landing place); the effect of various given conditions at liquid boundaries, of various size of computing areas, of errors in given predicted typhoon parameters (i.e. typhoon tracks, movement of the center, maximum wind speed, air pressure at the center and periphery); distribution of the potential and kinetic energies of the water volume during the typhoon activity.

The second part is related to the model chosen among a series of different versions of computing programs developed during the study of the typhoon surge problem. A coupling one and two dimensional model for describing transformation of typhoon surges into a river network as well as simultaneously modelling of typhoon surge process of the tidal motion will shown.

All things like that are necessary for calibration of the carried out model.

In the last part, after a careful calibration and validation of the chosen model, regime characteristics of typhoon surges along the coast line of Vietnam will be presented. Results obtained for prediction of the total water level in rivers and in the coastal zone including typhoon surges and river flow, tidal motion will be also reported.

THE BANYUWANGI TSUNAMI WAVE ON JUNE 3, 1994

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Observation of the effect of tsunami wave due to earthquake in the East Java was conducted at several locations along the south coastline of Kabupaten Banyuwangi, East Java from 12 to 15 of June 1994. The earthquake happened in the Indian Ocean at 10^{o}.20' S and Longitude 113^{o}.20' E at the depth of 1500 meters on 3 of June 1994 at 01:17:37.6 (WIB) with a strength of 5-7 to the Richter Scale. Damaged due to the tsunami wave occurred in six villages in the three Kecamatan namely Purwoharjo, Tegaldimo and Pesanggaran killed 206 lives, with 20 lives missing and 399 persons either minor or seriously injured. The same tsunami damaged 1226 houses, 426 small boots, and killed 15 livestocks with estimated loss of about 4 billion rupiahs.

Based on the two tide gauges data (tsunami signals), the average velocity (V) of the tsunami wave moving towards Meneng, Banyuwangi is 365 km per hour with period (T) 25 minutes, frequency (F) 2.4 cycles per hour and wave length (L) 152 km. The average velocity (V) moving towards Cilacap is 351 km per hour, with period (T) 35 minutes, frequency (F) 17 cycles per hour and wave length (L) 206 km. Prediction result shows variations in wave propagation time from the center of the earthquake to the two locations, Meneng and Cilacap. This is estimated from bathymetric data which have not shown good results. For future studies it is worth making bathymetric files for the Indian of Pacific ocean to predict propagation times in places with high occurrences of earthquakes.

IMPACT OF THE DISASTER TSUNAMI BANYUWANGI 1994

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Disatrous tsunami occurred in June 3th, 1994 in east Java. Tsunami destroyed houses at the fishermen villages, 206 peoples died and the shoreline retreated land ward. Prediction of the tsunami waves that enter the beach ridges at Rajegwesi approximately 1.52-3.90 meters above Mean Sea Level. At Pancer 2.3-2.95 meters above beach ridge and 5.08 meters above Mean Sea Level. Lampon 3.03 meters above beach ridge and 9.05 above Mean Sea Level and at Grajagan 1.08 meters above beach ridge. The height of the wave was predicted from the dry leaf along the beaches and from the pumices found at the foot hill. At Pancer, the shore line retreated to the land ward around 10 to 20 meters and the recent coral found on the beach face.

COASTAL PROTECTION THROUGH PREDICTION OF FLOORS CURING THE PASSAGE OF A TROPICAL CYCLONE

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The Philippines having the highest annual frequency of tropical cyclones in the world, is considered as a naturally storm surge prone area. During the passage of tropical cyclones over the archipelago, disastrous floods also results from it and inflict considerable damage to lives and properties especially along the low lying areas vulnerable to such natural hazards.

A numerical model for storm surge prediction was tested and a telemetered flood forecasting network of the Philippine (PAGASA) was alerted during the passage of a tropical cyclone that traversed the central portion of Northern Luzon, the tropical depression did not have relatively strong center winds, it induced rainfall due to the intensification of the southwest monsoon.

This case study dealt with the in-depth analyses of the observed water levels ant gauging station strategically located in an affected river basin in relation to the passage of tropical cyclone. The results showed that the storm surge generated has more significant effect in raising the sea level along the coast then river discharges even during widespread precipitation wrought by a tropical cyclone and/or the southwest monsoon.

THE SETO INLAND SEA COAST MONITORING PROGRAM USING NOAA AVHRR SEA SURFACE TEMPERATURE ESTIMATION AND VALIDATION

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The Seto inland Sea surrounded by Honshu, Shikoku and Kyushu islands, Japan, is one of the largest enclosed sea in the world. Its special scale is about 450 km in the east-west and 55 km in the north-south direction respectively. The size of the area is about 22,000 km^2 and the average depth is about 37 meters. The number of islands exceeds 700 and the population within the hinterland reaches 30 million, which may correspond to the population of 40 million in the United States, Great lakes region. In order to conserve and develop present and future environment of this fragile sea, it is inevitable to carry out a long-term observation. NOAA AVHRR's time series images acquired by the Tohuko University receiving station for the long-term monitoring of the Seto Inland Sea, which may be one of few applications of AVHRR time series images for the enclosed coastal sea except open oceans. An estimation and validation of the Seto Inland Sea surface temperature during the period of 1991 to 1992 are now in progress and is expected to be useful monitoring coastal sea environment.

THE TEMPERATURE AND SALINITY PROFILES IN THE EAST COAST OF PENINSULAR MALAYSIA DURING THE NORTHEAST MONSOON

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The Northeast Monsoon starts in the month of November to March every year in the east coast of Peninsular Malaysia. It brings strong wmd and heavy rain in the shallow water of this area. This will generate turbulence and mixing processes in the affected waters. This also has significant effect on the fishing industry in the area.

An oceanographic study was conduced in late October to early November 1993 in the east coast of Peninsula Malaysia. This area is quiet shallow with depth of Iess than 100 m. The aim of this study is to observe the mixing processes in the study area due to the coming of the Northeast Monsoon the study covers an area of 61600 sq. km. with over 29 sampling station Temperature and salinity data were collected using CTD.

The result of the study shows that the surface temperature ranges between 29^{O}C to 30^{O}C and the surface salinity ranges between 30.0 to 30.0 ppt. The different in temperature and salinity between the surface and the seabed are very small with only 2^{O}C and 1 ppt. difference for temperature and salinity, respectively. Temperature profiles of stations with depth Iess than 60 m, show no stratification in the water column. However, profiles at stations deeper than 60 m, show the present of benthic thermocline layers which disappear when the monsoon comes. Salinity profiles also Indicate a similar pattern.

CALCULATIONS OF THE MONTHLY MEAN OCEAN CURRENTS OF THE GULF OF THAILAND

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The climatological monthly mean current of the Gulf of Thailand have been calculated for every month by using a numerical model based on the two-dimensional shallow water equations. The simulated monthly mean currents and sea-surface show the characteristics of the seasonal variation of dynamic parameters in the Gulf of Thailand.

THE SEAWATCH THAILAND SYSTEM AN OPERATIONAL MARINE ENVIRONMENTAL MONITORING AND FORECASTING SYSTEM

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The oceans have always played a major role in the life of mankind, being perhaps the major supplier of food and also as a means of transport. The coastal areas have therefore always been the most attractive areas for human settlements. In today's world, when industrialization and increased pressure on all natural resources takes place, the oceans therefore also take the major threat on this most precious gifts from nature - a healthy environment.

Realizing this fact, IOC have launched the Global Ocean Observing System (GOOS), a system amongst others aiming at supporting an effective marine environmental management system. Implementing GOOS may help reducing the threat on our marine environment.

In this paper the SEAWATCH system, and advanced marine monitoring and forecasting system, consisting of a network of advanced data buoys transmitting data in real time, a reliable data analysis and control system, tools for environmental forecasting, including a number of numerical models and finally a computer based data distribution system, is presented.

The SEAWATCH system aim at fulfilling the GOOS requirements. This paper show examples from usage of the system which presently among other is installed in the Gulf of Thailand. Measured and modeled data from December 1993 is presented showing the system ability in the case of an approaching storm, enabling reduction of loss risks.

SEAWATCH INDONESIA : A MARINE ENVIRONMENT MONITORING AND INFORMATION SYSTEMS WITHIN THE GOOS CONCEPT

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The oceans on our dear Earth, the "Blue Planet" is at stake. These oceans, the marine environment, have served as the ultimate sink for the by-products of human activity since the very first day. Today we see that the cumulative effect of our discharges has finally exceeded the tolerance limit in many areas. The oceans illustrating the linkage and interdependence across national borders and generation must be saved. Our only option is to work together to overcome the dangerous trends threatening the human race and its natural environment. The oceans has huge resources which the coastal states have learned to use and obtain through centuries of experience. The oceans influence on the climate and the environment, also at he mainland, underlines the importance of monitoring and understanding the ocean and the marine environment. Indonesia, the "maritime continent"' is even more occupied by the marine environmental conditions than most other countries, as this environment represent the challenge for the industrialized countries within the 25 years advantage of establishing an ocean observing system, consisting of a network of advanced data buoys transmitting data in real time, a reliable data analysis and control system, tools for environmental forecasting, including a number of numerical models and finally a computer-based data distribution system.

This paper presents the plans for this system and some of the expected benefits thereof, starting with the environmental aspects and protection of the marine environment together with legislative and institutional developments. It is an attempt to integrate all activities in the framework of a cross-sectoral and multidiscipline approach to meet the requirements for the sustainable development in Indonesia. The system will support a wide range of areas, such as monitoring and forecasting of harmful algal blooms, environment impact on mangroves, seagrass and coral reefs, coastal and offshore circulation, tides, storm surges, climatic changes etc.

NUMERICAL MODEL FOR CIRCULATION IN THE UPPER GULF OF THAILAND

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The upper Gulf of Thailand is important for its natural resources, and as the reservoir of waste material from nearby cities. Over-utilizations of the Gulf have resulted in collapse of fish population, and deteriorate water qualities. Description and dynamics oceanography for the gulf areas is essential to better utilization of the gulf at its sustainable level. In this study, a 2-dimensional, Vertically-integrated tidal circulation numerical model is developed and calibrated in order to simulate the flow in the gulf. Model forcing functions are tidal elevations, river inputs, and homogeneous wind vectors. The model will be run to study the bay responses to different wind and river-input conditions. Eventually, the dispersion model can be incorporated to study the movement of dissolved substances such as salinity, pollutants etc.

OBSERVED MID-DEPTH CURRENTS IN MAKASSAR STRAIT, JUNE 1993 - JUNE 1994, AND ALONG-STRAIT SEA LEVEL SLOPS

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In June 1993, three current meter moorings were deployed across the north end of Makassar Strait. These moorings effectively monitored the mid-depth and deep flow for the period of one year. During this same period, the TOPEX/Poseidon satellite altimeter provided frequent estimates of sea level along the strait. Steric gradients were also available at two times for comparison.

The sea level "head" along Makassar Strait is through to drive currents which carry a majority of the exchange between the Pacific and Indian Oceans. However, its variability on the monthly to seasonal time scale is poorly understood. In this paper, the current meter data from the moorings are interpreted in terms of the slope of the sea surface, as determined by the altimeter data.

A COMPARISON OF THE WATER CIRCULATION IN THE GULFS OF THAILAND, CARPENTARIA AND PAPUA

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Extensive oceanographic data were collected for the Gulfs of Carpentaria (Australia) and Papua (Papua New Guinea). These data were used to calibrate and verify 2-D and 3-D models of the circulation. In the Gulf of Carpentaria a very strong non-linier interaction exists between high frequency (tidal) currents and low-frequency (wind-driven > currents resulting in long-term trapping of pollutants in shallow coastal waters. In the Gulf of Papua no such strong interaction exists. The influence of the open sea in driving the circulation in coastal waters is strong in the Gulf of Papua but weak in the Gulf of Carpentaria. These findings are extrapolated to the Gulf of Thailand, where current meter data are lacking, to map the likely zones of stagnation and of efficient flushing and help management by identifying likely pollution spots.

NUMERICAL EXPERIMENTS ON THE CIRCULATION OF THE SOUTH CHINA SEA

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Industrial development in coastal areas is demanding continuos research of the principal aspects related with coastal circulation. Its accurate knowledge will be extremely useful for the planification and execution of different projects of national interest, for the design of new offshore structures, for the planification of offshore operations and other impact of engineering works.

The main objective of this study is to simulate oceanic circulation caused by the NE and the SW monsoon in the South china Sea. The model solves the conservation equations of mass and momentum, vertically integrated. The numerical scheme is of second order, centered in space and time.

During the last three decades numerical models, based on the shallow water wave equations had been relatively successful in prescribing currents and sea level elevation due to tides and storm surges in coastal areas and estuaries. The vertically integrated models had been extensively used due to its simplicity and small computer time requirements.

The lattice is alternated in space. This grid is used to avoid the nodding produced by the high wave numbers. The model starts from rest. Every N (odd) time level an Euler-backward scheme is implemented to avoid the computational mode. To avoid undesirable effects of numerical inertial gravity waves the wind stress forcing is gradually increased via an hyperbolic tangent.

Open boundary conditions are implemented at the southern and eastern boundary, respectively.

DETERMINATION OF AN UPPER BOUND FRO THE WIND STRESS IN A LAYERED MODEL

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Usage of material surface present a very interesting feature in numerical weather prediction and oceanic modeling. The distinct advantage of semi-Langrangian models is the absence of vertical velocity (Cushman-Roisin, 1994). This in turn leads to a reduction of truncation errors in comparison to more conventional model (Shuman, 1961). The choice of a Langrangian vertical coordinate may improve numerical simulation by providing a better resolution in frontal areas. The number of grid points required in the vertical is greater in an Eulerian coordinate system than in a Lagrangian one (Bleck & Boudra, 1981).

Computational problems arise in the vicinity of the mountains. That is, in the intersection of isentrophic surface with the earth's orography. Because of the fact that the lower isentrophic surface boundary varies in space and time at the ground surface, the lower boundary conditions are difficult to codify (Kasahara, 1974). There is a natural tendency of isopycnals to intersect the sea surface in upwelled regions. The sea surface is a coordinate surface. Its intersection with other coordinate

surfaces, such as isopycnals, may cause numerical instability. The aim of this study is to find a criterion, that will allow integration to proceed, while preventing the isopycnals interface from surfacing.

MOORING OBSERVATION OF COASTAL CURRENT OFF KUALA TERENGGAUN, MALAYSIA

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Investigation of coastal circulation off Kuala Terengganu, Malaysia, is requisite both for coastal protection against erosion and preservation of marine environments. Marine activities during northeast monsoon from October to March are severely restricted due to strong winds, and the oceanographic data for the periods are limited. On 1 September 1993, an Alec Electro-magnetic current meter was moored at 17.8 m layer at 5° 17.59'N, 103° 14.28'E, water depth of 19 m, about 8 km east to Kuala Terengganu. A subsurface mooring was made by using as acoustic release of Nichiyu-Giken S-type. Recovery was attempted on 12 June 1994, but it did not come to the sea surface. About 10 days later, fisherman found the mooring system afloat at the site. Biological fouling by barnacle and oyster is assumed to have locked the release hook. Temperature and currents velocities at ever two hours are obtained for 269 days from 1 September 1993 to 27 May 1994. Temperature was 27.5 °C in December and January, and 29°C in September, October and April, although daily variation was 0.1 °C. Amplitude of tide current is 15 cm/s in spring tide and 2 cm/s in neap tide for east and north components. Although daily mean flow were observed. Daily mean varied with periods about 10 days.

EXPERIMENTAL STUDY OF WATER CARBONATE SYSTEM IN LARGEST RIVER ESTUARIES OF WEST PACIFIC

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At present the increase of CO_2 concentration in atmosphere is observed due to natural and anthropogenic factors. This increase can cause a global climate changes. Oceans occupy a two-third earth's surface, and are an active regulators of CO_2 in the atmosphere owing to buffer capacity of marine water. In addition, a carbonates removal with river waters considerable influence on the maintenance of CO_2 in marine water. The peach composition of marine water is substituting for carbonate composition of river water in the zone of marine and river water mixing.

Author of this article have been determined a carbonate system's elements during summer-winter period (1989-1992) within estuaries of some largest rivers such as the Anadyr, the Amur, the Yangtze, the Mekong, as well as in the Bering Sea, the Sea of Okhotsk, the Sea of Japan, and the East and the South China seas. Measurements of salinity, temperature, pH, total alkalinity, partial pressure of CO_2 in the marine waters were made during investigations.

Then the calculations of HCO_3, CO_3, total inorganic carbon content, carbonate and residual alkalinities was carried out by standard GEOSECS procedure for two systems : pH - total alkalinity and pH-pCO_2. Differences between these parameters for different systems were discussed and were determined the influence of river inflow and biological processes and the areas of carbonate mineral

transformation. Besides we used the mathematical factor analysis to determine the correlation between carbonate system's element and other hydrobiological parameters, i.e. salinity, pH total alkalinity, temperature, nutrients, total organic matter, particulate matte, phytoplankton content, primary production etc. On the bases of the results the maps of mentioned elements distribution of investigated areas were obtained.

The influence of a river inflow and biological processes on variations of the CO_2 water concentration and on estuary hydrochemical regime is discussed with the maps of space distribution of carbonate components and the Park's diagrams. The results indicate an active transformation of carbonate system's elements in the zone of marine and river water mixing.

TERRESTRIAL AND MARINE SEDIMENTS IN THE GULF OF PAPUA: ORGANIC CARBON, SULFUR, AND IRON RELATIONSHIPS

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There are a variety of studies indication that sedimentary C/S rations and pyrite (FeS_2) abundance may be useful as indicators of sources of detrital sediment and water column biological productivity. In our studies in the Gulf of Papua, these parameters have steep gradients from largely terrestrial inner shelf sediments to the marine carbonates of the outer shelf. The sedimentary concentration of total sulfur (largely pyrite) carries little (30-100 uMole/g) Fe/g, 0.1 to 1 uMole Co/g). Variations in the sedimentary ratios C/S and Fe/S appear to be by the supply rate of riverine detrital Fe and resistant organic matter, and not by sulfate reduction. Sulfate reduction rates are relatively low (4-6 uMole S/m^2. day) compared to water column algal production (17-75 uMole C/m^2. day) and benthic bacterial production (200-900 uMole C/m^2. day). Several sediment cores taken from mangrove intertidal sediments of the Fly River estuary show variations in C/S ratios that suggest separate decadal episodes of largely brackish and largely marine sedimentation.

GEOGRAPHICAL DISTRIBUTION OF DISSOLVED INORGANIC SELENIUM IN SEA WATER

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The behavior of selenium in sea water has been studies by investigation the horizontal distribution of Se (IV) and Se (VI) in the oceanic surface waters (Pacific, Indian, Antarctic, Indonesian Archipelago, china sea and Tasman sea) and their vertical distributions at 3 sampling sites in the northern and southern hemispheres Pacific as well as in the Pacific equatorial region during the various cruises of observation boats in 1990, 1991, 1992 and 1993.

Se (IV) was found relatively uniform throughout the whole oceanic surface water, except for the Antarctic Ocean. The average concentration in Antarctic Ocean was 78 ng/l and that in the other regions was vary from 4.7 (central north Pacific gyre) to 28 ng/l (east Indian). The high concentration of Se (IV) in the Antarctic Ocean indicated that the biologically uptake of Se (IV) by microorganism was limited due to the extremely low temperature of the sea water. In the case of Se

(VI), its concentration in the surface water of the north hemisphere was relatively higher tahn that of the south hemisphere. The average concentration was vary from 25 (east Indian) to 87.5 ng/l (China sea).

The presence of uptake of selenium by marine microorganism was supported by the vertical profile of both Se (IV) with the depletion in the surface and regeneration in the deep water. The maximum concentration of 50 to 60 ng/l for Se (IV) and 160 to 210 ng/l for Se (VI) was typical in the deep of bottom water.

THE TRANSFER OF RADIONUCLIDES IN MARINE FOOD WEB

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Transfer rule of Cs-137 and Co-60 in seawater and an artificial food web up of *Platymonas*, *Brachionus*, *Arca*, *Pemaeus* and *Tilapia* were studied. The results showed that the transfer of nuclide could be realized in a longer food chain in which seawater contained radioactivity. The transfer along food chain alone was slight, the pathway of nuclide uptaken by organism was mainly from seawater, but the presence of the food was helpful to the transfer of the nuclide. The transfer efficiency of Co-60 could be transferred along seawater - *Platymonas* - *Brachionus-Tilapia*, and Cs-137 could only be transferred from seawater to *Platymonas*. It showed diversified food chain transfer.

DEPOSITION OF ATMOSPHERIC PARTICLES TO THE EAST COAST OF ASIA

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Mineral aerosols from the Asian continent are the significant sources for the deep-sea sediments in the North Pacific. With this transport, pollution aerosol is also expected to be carried form the east coast region of Asia to the western North Pacific, especially in winter and spring.

In order to characterized this transport and atmospheric deposition of particles to the continental shelf region, we collected aerosol samples concurrently from Sapporo, Japan and Vladivostok, Russia. We also collected total deposition samples periodically in suburb of Sapparo city for two years.

Although both of our sampling sites are located to a large city, the variations in atmospheric concentrations of nss-sulfate and nitrate appear to be strongly controlled by large-scale atmospheric transport rather than local sources. On the basis of the atmospheric attempt to calculate the total deposition velocities and to estimate the atmospheric fluxes of these substances to the Japan Sea.

As estimated atmospheric deposition rate of mineral particle (1 mg cm^{-2} yr^{-1}) is similar to the settling rate of the surface sediment from the Japan Sea and the accumulation rate of the eolian dust on the Japanese Islands.

The impact of atmospheric particles should be determined on chemical and biological processes in coastal regions where it is less influenced by riverine input.

ATMOSPHERIC INPUT IN THE KUROSHIO OCEAN AREAS AND THE WEST PACIFIC

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According to the aerosol samples collected in the West Pacific Ocean during eight cruises under the China-US joint TOGA project from December 1985 to July 1990, monthly average deposition flux of crustal elements, pollutant elements and sea-salt elements were discussed. In November 1992 to March 1993 (TOGA-COARE), many aerosol samples, rain water samples and dry deposition sample were collected in the West Pacific (at 2 °S, 155° E). The dry and wet deposition in this area and its temporal variations were analyzed.

The Kuroshio ocean area is along the pathway for the minerals and air pollutants transported from Asia to the center North Pacific. Therefore, the atmospheric input to the Kuroshio ocean area was discussed, using the aerosol data collected in this area from 1989 to 1991 (China-Japan Kuroshio joint-investigation). At the same time, we will make comparison on atmospheric inputs between the West Pacific and the Kuroshio ocean area.

EXPERIMENTAL STUDY AND COMPUTER MODELLING OF OIL DEGRADATION IN NORTH-WEST PACIFIC REGIONS

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In the last years we studied the mechanisms of photochemical oxidation of saturated and aromatic hydrocarbons in laboratory experiments by influence of temperature and photocatalyzers. For these purpose we had made the two gauges which measured the photooxidation rates yields of organic peroxides and by oxygen absorption. We observed:

a) photochemical reactions yielded by mechanisms of physical and chemical sensibilisation;
b) aromatic hydrocarbons accelerated photochemical reactions;
c) in case of photoinitiated oxidation the oxidation rate depended from: type and concentration of photocatalyzer; films thickness; oil and water composition;
d) photooxidation stated within a few minutes after beginning of illumination and was more intensive then microbiological oxidation by adopted oil oxidizing bacteria in very favorable conditions.

In laboratory, natural sea and ice experiments with Sakhalin marine oil (the Sea of Okhotsk) we worked out the search and investigation of rates and mechanisms of photochemical oil oxidation in systems: air-oil-water, air-oil mousse-water, air-oil in water emulsion, air-oil-ice by influence of:

a) the rate of photooxidation depended from intensity of light;
b) intensity of sun light;

these results were received:

a) the rate of photooxidation depended from intensity of light;
b) the oil-water surface dumped the photooxidation rate;
c) high molecule products such as resins and asphaltenes were formed by photochemical oxidation;
d) photooxidation stated within a few minutes after beginning of sun light illumination and was more intensive then microbiological oxidation by natural community of oil oxidizing bacteria Computer modelling was used for description of these experimental results.

COMPUTER MAPPING OF TARAWA ATOL

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Data collected in several countries will be compiled and compared. The data include beach profiles, comparison of aerial photography from the 2nd worldwar up to now, satellite images, bathymetric data, from countries including Kiribati, Western Samoa, Tonga. A species focus will be on Tarawa Atoll.

Tarawa is an interesting example because of its situation close to the equator, of a complete set of aerial photography, of the importance of the demographic pressure and of the volontarist action toward connecting th islet by causeways. The influence of those factors will be examined. Examples of integration of those data as part of a Geographical Information System will be given.

THE SHALLOW AND DEEP WATER MONITORING USED IN THE OCEAN DYNAMICS EXPEDITIONS 1994/1994

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Two bottom-mounted Acoustic Doppler Current Profilers (ADCPs) were deployed for several month-periods in Malacca and Singapore Straits in depths of 60-70 m. The bottom mounted assemblies were specially developed for the project and each consisted of an instrument package mounted inside an expendable 3-tonne concrete anchor taking the form of a truncated pyramid. This was lowered to the seafloor by the deployment vessel. The package included a release that was triggered by a acoustic command by the recovery vessel. A total of 5 deployments and recoveries were made successfully. Some problems were experienced with the ADCPs, but the data that were collected showed a variety of tidal and non-tidal phenomena. The sampling interval in the vertical was 1 m.

Farther east, three moorings with ADCPs and conventional current meters were deployed in Makassar Straits where depths ranged from 1500-2500 m; one mooring was deployed in the Maluku Sea in d depth of 2500 m; and one was deployed in the Halmahera Sea in a depth of 900 m. The deep water moorings were deployed for a little over one year and were of a standard design. All

the water moorings were recorded. The ADCPs returned no data because of a severs fault that was found by the manufacturer after the deployment expedition. Nineteen of the twenty conventional current meters returned good data on tidal and non-tidal phenomena.

The Malacca Straits shallow water mooring activities were made in collaboration with the Royal Malaysian Navy. The Singapore Straits shallow water mooring activities were made in collaboration with the Port Authority of Singapore. The deep water mooring activities were made in collaboration with LIPI, BPPt and DISHIDROS in Indonesia. The ASEAN-Australia Economic Cooperation Program (AAECP) is funded by the Australian International Development and Assistance Bureau and the Marine Science Program is managed by AMSAT Ltd.

This paper discusses the mooring design and performance, as well as preliminary findings from the data.

RAPID FLOODING EVENTS DUE TO EPISODIC SEA LEVEL RISES AND THEIR IMPACT ON THE EVOLUTION OF TEXAS COASTAL ENVIRONMENTS

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The evolution of the Texas coast and several bays during the Holocene was examined using vibracore, borehole, and high resolution seismic data. These data indicate the presence of mappable surfaces that are normally marked by abrupt changes in faunal assemblages, cohesion, color, lithology and seismic facies. These surfaces are associated with abrupt and extensive landward shifts of deposition environments and are interpreted to reflect rapid flooding events caused possibly by episodic sealevel rises. The latest of these flooding events, which may have occurred 4 ka, led to the development of the present coastal systems along the Texas Gulf Coast. The establishment of the present coastal systems appear also the have occurred very shortly, within 500 years, after the flooding. Ongoing work focuses on; (1) obtaining more radiocarbon dates to better constrain the timing and duration of the flooding events, (2) establishing the synchroneity of the flooding events within the different Texas bays, and (3) refining the flooding surface maps to arrive at better estimates of the magnitudes of the possible episodic sealevel rises.

QUATERNARY EUSTATIC SEA-LEVEL VARIATIONS AND THE LOST EPICONTINENTAL SEA IN INDONESIAN MARITIME ISLANDS: RESPONSES AND IMPACTS TO THE GLOBAL CLIMATIC CHANGES (A STATE OF THE ART ON THE GLOBAL CLIMATIC STUDY)

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The thousand islands of Indonesia, situated between two continents and oceans, may be called "the maritime continent". It has the largest coastal plain in the world with extensive lowland areas' subject to sea level change, as well as to large, as well as to large, shallow and stable continental platforms (Sunda and Sahul) that cover more than one third of the archipelago. The Indonesian island are has a critical geographical setting in relation to regional and global climate changes. The tropical monsoon system, between Asia and Australia, prevails in this area. The global

current system of the Pacific and Indian oceans passes through the strait corridor and rises to the continental platform, bringing rich nutrients that support reef development. This system was disturbed by changes in island are bathymetric features during the glacial low sea level. However, the deep Indian Pacific Ocean Gateways passage remained open and allowed deep global ocean currents to flow continuously between the expose platforms.

Some evidence suggests that small climatic changes in southeast Asia may help to initiate and modulate global event. The unusual sea-surface temperature changes in this area may be major causative factors in the ENSO phenomena. A major factor in the south Asian atmospheric circulation is the regular changes at the sea surface (temperature, salinity, etc.) due to anthropogenic effects (coastal and marine pollution, gas emission, reduction of vegetation, changes in the hydrological balance, albedo, etc.) may induce unusual changes in the seasonal circulation. Natural processes (volcanic eruptions, floods, etc.) may strengthen these local effects.

SEDIMENTATION IN NORTHERN PART OF LAKE TONLE SAP, CAMBODIA

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Lake tonle Sap, the largest lake in the Indochina Peninsula, lies in central Cambodia. Unique sedimentation is expected in the lade due to drastic changes in its water area between the rainy and dry seasons. As the first step to examine the sedimentary processes or the lade, bottom sediments of the lade and the Tonle Sap Rive, and surface soils of alluvial deposits were collected and examined in order toe reveal the origin of the lake bottom sediments.

As the results it becomes clear that clay minerals in the bottom sediments of the northern part of Lake Tonle Sap are derived both from surface soils on the alluvial deposits around the lade, and metamorphic and granitic rockbodies lying in the Mekong River basin. The latter is transported, as suspended sediments by backward current in the rainy season, into the lade from the Tonle Sap River.

The presence of marine creatures in bottom sediments of the lade suggests that the lake was closely connected with the sea during the last sea level high stand. Furthermore, there is a strong possibility that annual changes due to alternating rainy and dry seasons will be recorded in the lake bottom sediments over the long geological period.

EXPERIMENTAL INSTABILITY OF WEST PACIFIC MARGINAL SEAS

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As compared with the open ocean, margina Iseas are much more sensitive to environmental changes, natural of Anthropogenic. Heavy exploitation of a marginal sea and its coastal areas causes serious environmental problem such as eutrophication and pollution of the Baltic and North Seas. For many parts of the West Pacific region where economy develops rapidly but exploitation of marginal seas is still at an early stage, the opportunity exists to learn from these examples and to consider "environmental capacity" of each individual sea in planning its exploitation and

management. Depending on climatic, geomorphic, hydrodynamic and sedimentological controlling factors, environmental capacity varies from sea to sea, with those of enclosed-basin type and shallow-bark type more vulnerable to environmental changes. An example is the Sea of Japan where the glacial low sea-level stand brought about anoxia, while the deeper sill depth, high sedimentation rate and active turbidite currents prevented anoxia in the Sulu Sea and the South China Sea.

Aside from the chemical or biogeochemical aspects there is physical instability of marginal seas. The emergence/submergence of extensive shelf seas is the most conspicuous geographic response to glacial cycles in the West Pacific region. Both the reduction of sea area and the enhanced decrease of sea surface temperature caused by the glacial low sea level result in a lowered evaporation rate and hence, intensified aridity in Asia hinterland.

NEOTECTONICS OF THE GULF OF THAILAND

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Deposition of Cenozoic continental sediments in structural basins which formed to the west of Khorat Plateau suggests changing of tectonic regime which was coincided with and related to the collision between peninsular India and Asia. The collision resulted in the stop of clockwise motion of the south China. Subsequently, twisting stress disappeared while southeast Asia relaxed and gentle basins began to form its western side.

Tensional regime started to develop in the south by the opening of the Gulf (Bunopas and Vella, 1983) and initiated systematic north-south trending normal faults. The orientations of these faults are parallel to those of recent movement of the oceanic crust descending beneath Indonesia. the presence of north-south trending normal faults and dextral northeast to east-northeast trending strike-slip faults indicate east-west spreading motion in the Gulf.

The climax of tensional faulting which coincides with the main uplifting phase of the present mountains was indicated by small, widespread Tertiary to Quaternary basalts. Peneplained tops and youthful geomorphology of the mountains contain infrequently Quaternary deposits which were uplifted to great elevation. Quaternary deposits are rudaceous and are contrast to those of Tertiary deposits suggesting a rapid uplifting during Quaternary age (Bunopas, 1981). Tertiary Mae Moh Basin for example, was formed by post-middle to late miocene normal faulting (Vella, 1983) suggesting that the formation of other basins in northern Thailand is similar to those of the Mae Moh basin.

Late Cenozoic deposits may have taken places upon but also enlarge their deposition upon and on ass sides of the more restricted Tertiary basins. Occurrences of late Cenozoic gravel and sand beds which are currently elevated to several meters above recent alluvial basins suggest a very young regional uplifting. Probably before the young regional uplifting the whole areas of Thailand were occupied by a less vegetation flatter ground. Accumulation of gravels and sands beds with rare embedded fossils woods can be found after long denotation.

SEDIMENTATION OF THE 1960 CHILE EARTHQUAKE TSUNAMI DEPOSITS IN MATSUSHIMA BAY, NORTHEAST JAPAN, AND ITS ECOLOGICAL IMPACTS

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The Pacific coastal areas of Northeast Japan suffered damage from the Chile Earthquake Tsunami in 1960. However, coastal areas in Matsushima Bay were less damaged because the bay is sheltered from the Pacific by several small island situated in the bay mouth area. Thus, the tsunami waves were mostly obstructed by these islands, but flowed partly into the bay through several narrow channels situated between these islands.

Thirty-two surface and 17 cored sediments were collected in and around the bay in 1991 and 1992, and a sandy layer formed probably by the 1960 Chile Earthquake Tsunami were detected in five cored sediments inside of the bay. The tsunami deposits, intercalated in homogeneous muds, consist of lower parallel stratified and upper bioturbated sand layers in each core. Erosional surfaces are internally observed within the lower layer.

In bay-head area of the bay, inner bay species of benthic foraminifers dominate in tsunami deposits, however outer bay species are dominant in those from the bay mouth area, indicating that sandy sediments distributing on shelf outside of the bay were carried into the bay mouth area by tsunami waves. On the other hand, sandy sediments distribution on coastal area around bay-head area were dragged into the bay-head area by back currents of the tsunami.

Underlying mud layer of tsunami deposits mainly yields inner bay species of benthic foraminifers, but middle bay species are dominant in the overriding mid. Accordingly, it is concluded that environments Matshushima Bay have been shifted from inner bay to middle bay by the tsunami.

MARINE TERRACES AND DIFFERENTIAL UPLIFT ALONG THE MARGIN OF ACTIVE PLATE

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The inner and outer belts of the Indonesian Arcs are intensively influenced by active vertical uplift during the Quaternary period. This uplift that interferes with the sea level variations, has produced many terrace flights. The less developed marine terraces of clastic reefal limestone covers conformably the marine elastic sediments associated with the volcano-clastic deposits in the gentle slope of the island in the active volcanic inner arcs. The good series of coral reef terrace are observed in the islands of the non volcanic outer arcs, but the luxurious one has developed upon the marly substratum in the north coast of East Sumba that brings some new informations of neotectonic, instead sea level variations and climatic changes since the Quaternary period.

Using ^{14}C, $^{230}Th/^{234}U$ and ESR dating method, the chronostratigraphy of the terrace sequence can be determined. The time development of the main terraces has a good coincidence with some high sea stands of the Quaternary interglacial sequences.

Based on the status (position and the age) of the continuous spatial distribution of the Quaternary reef limestone terraces, the spatial differential rate of vertical deformation in those arcs can be figured out. In Timur, Flores and Sabu Island, the coral reef limestone has been influenced by a reactivated Quaternary fault during its formation, while there is no structural deformation has been observed in the Sumba limestone. It's possible that the uplifts have been preceded by quite high magnitude seismic shock.

Plate boundary configuration and local tectonic evolution pattern may be the main control of those differences. The hydroisostasy (rheologic and hydrostatic effect) is the other possible influence.

TECTONIC APPROACH ON CHANGES IN SURFACE WATER CIRCULATION BETWEEN THE TROPICAL PACIFIC AND INDIAN OCEANS

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Full theme of IGCP355 is "Neogene evolution of Pacific Ocean Gateways and associated responses to paleogeography and paleoclimatology in time and space, with special emphasis on Pacific- Indian Ocean Seaways". The scopes of the IGCP355 are to elucidate. (1) Precise geophysical and geochemical measurements combined with biostratigraphical and biochronological methods is selected areas of Indo-Pacific regions to clarify the Neogene tectonic developments around the Pacific-Indian Ocean Seaways and (2) To elucidate associated global responses in paleobiogeography, paleooceanography and paleoclimatology in special reference to the relationships between opening or closing seaways and Pacific Neogene events.

One of our results is the tectonic approach on changes in surface water circulation between the tropical Pacific and Indian Ocean. This paper outlines the tectonic framework of Indonesian region throughout Tertiary time in a series of reconstruction, and considers the constraints that this implies for microplate motion and basin Histories. Important changes occurred in biogeographic patterns which is interpreted as reflecting major change in surface water circulation of Indo-Pacific region.

The Indonesian seaway would effectively have been closed during Middle Miocene, preventing further surface water circulation between the tropical Pacific and Indian Oceans.

COASTAL HAZARD MAPS

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The coastal areas in the WESTPAC region have suffered from several natural disasters. The purpose of this paper is to discuss coastal natural hazards from the standpoint of disaster science and the possibility of making coastal hazard maps.

Natural disasters occurring in the coastal zone are coastal structure failure, coastal erosion, flood including tsunamis, ground failure, land subsidence, and volcanic disaster. It is clear that these disasters have three phases of their structure. The simple cause of the disaster is natural phenomenon itself and is classified into 7 categories; typhoon, tide and wave, tsunamis, heavy rain, earthquake, sediment consolidation, and volcanic eruption.

When a natural phenomenon becomes a disaster, it has certain character to attack human community. The character of the natural phenomenon has important aspect for description and is here called the disaster parameter. The disaster parameters to be discussed are listed for each natural phenomenon (Table 1). When a regular disaster develops to a fatal casualty, it needs to be affected by district characters. Such a district character is called the intensification factor for the giant disaster. They are listed in the Table 1.

The proposed coastal hazard maps are consisting of two sets of maps; one is "the natural hazard map" which contains the disaster parameters observed in the past natural hazards: the other is the "natural disaster prediction map" which contains both disaster parameters and intensification factors.

BIOPRODUCT EXTRACTED FROM LOCAL MUDSKIPPER SPECIES AS HEALTH FOOD FOR HUMAN AND ANIMAL CONSUMPTION (POSTER)

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Mudskippers were collected from mudflats of Kelantan and Terengganu in middle 1992 to early 1993. He dominant mudskipper species in the mudflat community comprising of *Periophthalmodon schlosseri* and *Periopthalmus vulgaris*, both of which accounted for more than 80% of the mudskipper communities. Approximately five or more other species of Mudskippers were also found in other region especially Sabah situated in the south east Malaysia. The lipid contents in mudskipper were high. The major fatty acid contents of the Mudskippers showed high concentration of 16:0, 18:0, 18:2w6 20:4w6 20:5w3 and 22:6w3. It also contained high w3 highly unsaturated fatty acid series.The arachiodonicacid (20:4w6) content was high in Mudskippers for the prostaglandin production in the body. Prostaglandin is the localised regulatory hormone which control various bodily physiological activities. Other neutral lipid classes such as sphingomyelin (responsible for child intelligence) triacyglycerols and cholesterol ester were also present in significant amounts.

THE BIOCHEMICAL AND NUTRITIONAL PROPERTIES OF CERTAIN INDIGENOUS MALAYSIAN BACILLARIOPHYCEAE AS FOOD ORGANISMS FOR FISHLARVAL REARING IN LOCAL HATCHERIES (ORAL)

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Malaysia is endowed with a great diversity of algal species in the South China Sea surrounding peninsular Malaysia. Among the algal species, certain diatom species (especially *chaetoceros* sp, *Navicula* sp *skeletonema* sp) are utilized extensively in mariculture as food for all growth stages of bivalves for larval stages of some crustacean and fish, as well as or rearing zooplankton (e.g. rotifers, copepods and brine shrimp. Diatoms show wide variation in their content of protein carbohydrate and lipid, although this may not always relate directly to differences in their carbohydrate and lipid, although this may not always relate directly to differences in their nutritional value. The amino acid composition of the diatom are similar, and unlikely to account for major differences is nutritional value. The fatty acid composition of diatom varies significantly. The polyunsatured fatty acids 20:5n3 and 22:6n3 appear to be closely related to nutritional value; diatom

lacking these acid are usually rich in these acids. Other nutrients, such as sterols, vitamins and minerals, which occur in varying proportion, may also relate to difference in nutritional value, the total ash, chlorophyll, phaeopigment lipid and fatty acids contents of selected diatom species (*chaetoceros malaysia, Navicula gracilis and Skeletonema costatum*) used in tropical Malaysian mariculture were studied, the axenic laboratory cultures were grown in f - 2 medium, while outdoor cultures were grown in a commercial medium designed for optimum nutrition in tropical outdoor aquaculture operation. considerable amount (ca 10% of the total fatty acid) of the polyunsaturated fatty higher than chlorophyll a. There was as increase with culture age in the relative proportion of total C18 and C20 fatty acid components. The diatom contained the w3 - polyunsaturated fatty acid (PUFA) necessary for the growth and survival rate of the fish larvae.

OBSERVATION OF ABUNDANCE AND DENSITY OF FISH ON DESIGNED MODULES OF ARTIFICIAL REEF

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Five designs of modules were set up in an area located 1.2 nautical miles from the beach of the Fisheries and Marine Science Center, UPM Kuala Terengganu in early April 1993. The modules were constructed using three different materials namely concrete, used tyres and bamboo. The designed modules were tested for their ability of aggregate and to enhance fish and its population. Underwater observations commenced from April 1993 until May 1994 show a significant difference in temporal abundance and density of fish between the designs. Observation was put on hold from December 1993 until February 1994 due to the monsoon season. From the number of species that were found and their abundance rank, Concrete-Bamboo modules followed by Concrete-Table modules show a higher rank in the fish abundance and density.

TAXONOMY, BIODIVERSITY AND CONSERVATION OF THE FISHES OF STRAITS OF MALACCA

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Taxonomy of Malaysian fishes is at its infant stage. Study conducted between January 1986 to December 1993 has revealed the presence of 20 orders, 98 families, 503 species of cartilaginous and teleost fishes from the straits of Malacca. The most productive area in terms of spices richness seems to be the central region of Malaysia, as one moves southward the richness index decreases. Out of 503 species 250 of them are found to be commercially important as food fish and about 10 of them are used in traditional medicine by the village traditional 'doctors'. Most of the nonfood fishes are being used now in the preparation of fish meal.

With the advent of biotechnology new possibilities to manipulate individual genes so as to modify fish genetic makeup is getting a new momentum. but the sophistication of gene transfer technology is still beyond our capability. A conservation plan of a) areas of conservation in the form of marine park, b) red data book on endangered spices, c) strict legislation for the catching method of fish, d) education of the public to conserve biodiversity and e) a complete list of the fishes of the area are emphasized.

UNJAMS (FADS) AS SUBTRATES FOR FOOD ORGANISMS

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Thigmotropism in fish or the desire to be close to a solid object has been manipulated by many fisheries for successful harvesting operations. Various hypothesis have been proposed to explain why floating artificial habitats are generally successful in attracting fishes. Food was hypothesized to be one of the common stimulus for aggregations of some species around unjams. This study attempts to unveil that sessile organisms which readily encrust unjams, a traditional Fish Aggregating Devices (FADs), at sea are in fact important food organisms for fish. A new group of unjam was installed in a traditionally rich fishing ground. The organisms for fish. A new group of unjam was installed in a traditionally rich fishing ground. The organism encrusted coconut fronds were taken from the unjam every two weeks for identification under a Scanning Electron Microscope. Ten species of the organisms which encrusted different parts of the after immersion were identified. The density of the organisms with time of immersion was estimated and found to be fluctuating with time and this could be related to the feeding of fish. Free-floating organisms collected from the water around the unjams were also identified. Stomach content analysis on fishes caught around the unjam were conducted. Organisms found in the stomach of fish caught around the unjams were then related with the encrusted organisms found on the unjams.

STUDIES ON LIVE BAITFISH FOR THE TUNA INDUSTRY IN EASTERN INDONESIAN WATER

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Pole-and-line fishing for tuna is a multi-million dollar industry in eastern Indonesia that employs many people, supports several canneries and generates export income. Its development is presently constrained by a shortage of baitfish, the important species of which are also utilized as human food in this region. There is a lack of data on the exploitation and biology of the baitfish used by the fishery in Indonesia. Following approaches by the Indonesian government to CSIRO and formal requests to ACIAR this project will aim to characterize the fishery, provide stock assessment and biological data, assess the interactions and socio-economic structures of the various fisheries exploiting baitfish species, train Indonesian fishery scientists, and develop appropriate management plans for the sustainable use if baitfish. The study will capitalize on the experience and expertise gained during previous successful ACIAR funded CSIRO studies of tuna baitfish in the Pacific and Indian Oceans. The Indonesian government accords the project high priority and is willing to contribute both resources and funds to it but lacks scientific and coordination expertise available from Australia.

THE BIOLOGY, ECOLOGY AND LIFE-CYCLE OF TERUBOK (*TENUALOSA TOLI*) IN SARAWAK

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"Ikan Terubok" is the local Sarawak name for the clupeid fish *Tenualosa toli*. This species formerly occurred in large numbers in the estuaries of Sarawak but has recently undergone a

dramatic decline. It has long been a prized target for fishermen initially as a food fish but latterly for the high price commanded by the roe. The Sarawak Government has initiated a study into Terobok in order to ensure its continued survival in the country.This study is taking the form of a collaborative research project drawing upon the expertise and personnel of a number of organizations led by CSIRO Division of Fisheries and coordinated by the Inland Fisheries Branch, Sarawak.

AGGREGATION OF CEPHALOPODS ON A SPECIFIC DESIGNED ARTIFICIAL REEF MODULES

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Underwater observations on five designed artificial reef modules show that Concrete-Table modules can aggregate cephalopods. Throughout the observations which took place from April 1993 until May 1994, two species of cephalopods were known to have been present and aggregate on the modules namely, oval squid *Sepioteuthis lessoniana* and cuttlefish *Sepia pharaonis*. Their presence were marked by observed individuals and also egg clusters deposited on the modules. Selectivity of resting area and their deposition of egg on the modules occurs within species. Numbers of individuals aggregated on the modules in each month also counted through jigging activities.

CEPHALOPODS OF TENGGARA, WITH NOTES ON PROBABLE CAUSE OF RESOURCE DEPLETION

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Twelve species of cephalopods exist around West Nusatenggara water, namely: *Nautilus pompilius, Argonauta* sp,. *Sepia latimanus, S. bandaensis, Sepioteuthis lessoniana, Logigo edulis, L. chinensis, L. sibogae L. beka, Uroteuthis bartschi, Sthenoteuthis oualaniensis* and *Chiroteuthis* sp. Annual cephalopod catches in the area consist primarily of squid, *Loligo edulis* and *L. chinensis*, which in 1978 attained a total catch of 1,200 tons. In 1990, however, the catch was only 180 tons. Some probable causes of this remarkable decrease including heavy fishing pressure, recruitment failure and environmental influences are discussed and suggestion for future work outlined.

ARE THE CORAL REEFS ALONG THE COAST OF WEST SUMATRA SERIOUSLY DAMAGED?

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Research on the condition of coral reefs the coastline of West Sumatra is carried out since October 1992 using standard methods like manta-tow and line-transect. The area investigated at a radius of 30 nautical miles around Padang city comprises almost 5000 km^2 and about 86 reefs and small islands. Our results indicate that about 74 % of all investigated locations are seriously damaged (percentage cover with life coral; PC= 0-2 %), about 22 % of the locations are moderately damaged (PC = 25-49 %) and only 3.7 % of the locations are in good or very good condition. Comparative studies indicated the most of the damaged is caused by fishing with destructive method, above all blast-fishing. It is recommended that the provincial and central government react fast by strictly enforcing the existing laws and at the same time select areas for protection.

THE IMPORTANCE OF CORAL REEFS AS SEAWEED RESOURCES IN INDONESIA

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Most Island Of Indonesia have coral reef formations which are potentially impotent as seaweed resources. These coral reef islands mostly form fringing reefs. Some species of Indonesian economic seaweeds such as Eucheuma spp., Gracilaria spp. and Hypnea spp. are exploited naturally from coral reefs at coastal waters. However, today a large number of Eucheuma is a product of cultures conducted at several coral reef areas of Sumatera, Java, Bali, Sulawesi, Nusa Tenggara and the Mollucas. These areas may also serve as potential sites for other economic seaweed species which crops still depend on the natural stocks.

VARIATIONS IN ATMOSPHERIC AND OCEANIC CO_2 IN THE WESTERN NORTH PACIFIC AND ESTIMATION OF THE CO_2 FLUX AT THE AIR-SEA INTERFACE

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In 1990, the Japan Meteorological Agency initiated a shipboard (R/V Ryofu-Maru) observation of atmospheric and oceanic CO_2 along the fixed observation lines (*e.g.* at 137 °E from 34° to 3°N in winter and summer, at 155°E from 30°N to 4°S in summer, etc.) in the western North Pacific and in the seas adjacent to Japan, from the observation in the past four years (1990-1993), it is found that atmospheric CO_2 in the south of 30°N has increased drastically between 1990 and 1991 in winter (4.0 ppmv/year) and summer (4.5 ppmv/year), whereas it showed small or sometimes negative growth rates between other two successive years. On the other hand, oceanic CO_2 showed a significant increase especially in low latitude in both the seasons of the years 1991-1993, compared to the values in 1990. Oceanic CO_2 normalized at a specific temperature also revealed significant increases in the period, but showing larger and smaller increases compared to the non-normalized case for winter and summer, respectively. This fact implies that increased oceanic CO_2 in summer can be explained to some degrees by changes in surface seawater temperature. The increase in oceanic CO_2 is probably related to the 1991/92 ENSO event while the mechanism of the irregular growth rate of atmospheric CO_2 is left unsolved.

Estimation of the CO_2 flux in the extended area (130°E-160°E, 30°N-0°) for the normal year of 1990 (neither El Nino nor La Nina) was attempted by assimilating CO^2 data observed separately in the area. In doing so, some findings were obtained as follows: (i) the 1° X 1° grid point values of atmospheric CO^2 have been successfully reproduced by considering the distinct seasonal change and by applying regression surface over the region; (ii) the grid point values of oceanic CO^2 were obtained by utilizing its empirical temperature dependency (ppmv/°C) which accords to the slope of a linear regression. In the region north of 10°N, the temperature dependency is well applied, but in region south of 10°N inclusive, no good temperature dependency was obtained; (iii) for oceanic CO_2 in the region north of 10°N, data observed in other years are available by considering the interannual differences of mean values of each region; (iv) the western North Pacific becomes a source and sink

of CO_2 in summer and winter, respectively. As a total, it is a sink of 19.6 MtC or 45.3 MtC, showing a large difference according to the formula for the calculation of CO_2 gas transfer velocity.

TRANSPORT AND STORAGE OF CO_2 IN INDIAN OCEAN: AN OCEAN-CIRCULATION MODEL FOR CARBON CYCLE

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A two-dimensional model of the carbon cycle in Indian ocean has been developed. The model is based on a dynamic, general circulation model of the world ocean created by IAP. The effect of the ocean biota on carbon cycle is coupled into the model. Chemical species important to the carbon cycle are advocated by the current field of the general circulation model. Mixing occurs through numerical diffusivity (related to tinite box size), a small explicit horizontal diffusivity, and a convective adjustment. An atmospheric box exchanges CO_2 with the surface of Indian ocean.

Six tracers in the Indian ocean (i.e., suspended organic carbon, suspended inorganic carbon, total dissolved inorganic carbon, total alkalinity, dissolved nutrients and dissolved oxygen) are simulated, and model distributions are compared with distributions observed during the GEOSECS and other expeditions. The radiocarbon isotopes ^{14}C are used for calibration. If finds that ocean tracer distributions are very sensitive to horizontal eddy diffusion coefficient (Kh) and the rate constant for photosynthesis (GK). The steady state distribution of total carbon between; the Indian ocean and atmosphere are dependent on various processes and boundary conditions of the model. There is an intimate relationship between ocean circulation, biological processes in the ocean, nutrient contents, the effect of ocean warming, and atmospheric CO_2 concentration.

AIR TEMPERATURE VARIATIONS AND ENSO EFFECTS IN INDONESIA, THE PHILIPPINES AND EL SALVADOR

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The major features in development of the "El Nino - Southern Oscillation" (ENSO) involve oscillation of the Pacific ocean-atmosphere in an essentially unpredictable (chaotic) fashion. The system moves between extremes of so called "warm events" lasting one or two years and involving movement of warm sea water from the western Pacific along the equator to impact on the west coast of the American continent and "cold-events" associated with easterly trace-wind induced flows of colder water from the eastern Pacific towards the west. Historical data indicate that ENSO years as experienced by the Island of Java are either much warmer than non-ENSO years or only slightly, if at all, warmer than normal (non-ENSO) years. Hot-dry years within the ENSO warm eventcycle are almost always followed by cooler wet years and vice-versa. This pattern also extends to include the year immediately following the terminal year of an ENSO warm event set. The initial year of an ENSO warm event set may be either hot with a long dry season or relatively cool (nearer to the temperature of a non-ENSO year) and having a short dry season. In recent years, since 1950, of the 9 ENSO warm events, the initial year tends to have been hot and dry for 6 (1951, 1957, 1963, 1972, 1982, 1991) and neutral or cool and wet for 3 (1968, 1976, 1986).

An area of 88,000 ha burned in 1991 (Jakarta Post 30 November 1991) largely in Kalimantan in association with the 1991-1992 ENSO event, an extensive pall of smoke developed over Kalimantan, Singapore and Malaysia during September-October of 1991. Surface vegetation-based fires continued to burn in East Kalimantan as of April 29, 1992 and extended into the 1992 dry season, in response to the ENSO conditions carrying forward from 1991.

The increasing annual trend in air-temperature exhibited by the mean monthly values over the period 1866-1993, for the Jakarta and the Semarang data taken together is 1.64°C (0.0132°C per year from 25,771°C to 27,409°C). The major industrial development in infrastructure for Jakarta has been significant only since 1980 or so and was not apparent before 1970 when the city had the aspect of an extended village with few large buildings (greater than 34 stories) and no extensive highways. The 1.65°C difference between 1866-1991 can presumably be partitioned into:1) urban heat-island effect, 2) effect of deforestation, 3) effect of secular micro-climate shift, 4) influence of general global warming with particular reference to the tropics.

When the blocks of non-ENSO years in themselves are considered, the deviations from the secular trend for warmest month mean temperatures in successive years are correlated with that of the next immediate year deviation so that either continual warming or cooling appears to take place from the termination of one ENSO to the initiation of the next. When the deviations around the secular trend shown by the warmest month average temperatures are summed for the inter-ENSO intervals (the separate non-ENSO years) the resultant "heat-loading" index is positively correlated with the following (initial) ENSO warmest month deviation from the overall ENSO warmest month secular trend. This provides an immediate predictive mechanism for the likely strength of an ENSO, in terms of the dry season impact to the Island of Java, should one occur in the next year to break a non-ENSO sequence. The length of the build-up and the build-up achieved seems not to be related. The relationship does not in itself however, predict the occurrence of the "next" ENSO.

EFFECT OF ENSO ON THE CHLOROPHYLL DENSITY OF COASTAL AND OFFSHORE SURFACE WATER IN THE NORTHWESTERN SUBTROPICAL PACIFIC IN WINTER

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Most of the small pelagic fish in the temperate water spawn in the coastal and frontal regions of the Kuroshio during winter and early spring. Their larvae predate mostly copepod nauplius whose abundance is thought to be dependent on chlorophyll density in the surface water. Hence, to make clear the characteristics of spatial and year-to-year variations in the surface chlorophyll density around the spawning and the nursery grounds are important to understand the year-to-year variations in the feeding condition of the fish larvae.

In the subtropical water, surface chlorophyll density becomes maximum in winter. Subsurface chlorophyll maximum is formed in the upper seasonal thermocline except in winter in the northern subtropical gyre when the seasonal thermocline is destroyed through mixing down to the permanent thermocline in a few-several hundred meter (deeper than the compensation depth).

Hence, the surface chlorophyll density in winter in the Northwestern Subtropical Gyre and its coastal water, including the coastal boundary region of the Kuroshio off the southern coast of

Japan, becomes lower in the years with stronger winter monsoon than in the years of calm winter under El Nino. Whereas, the surface chlorophyll density in the southern part of the Subtropical Gyre becomes higher in the years with stronger winter monsoon.

SPATIAL TIME DISTRIBUTION OF CHLOROPHYLL-A IN THE WESTERN TROPICAL PACIFIC OCEAN

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Based on data collected on board of R/V "Shi Yan 3" and others from TOGA COARE cruise during November 1992 to February 1993, this paper deals mainly with spatial time variations of chlorophyll-a and phaeopigment in the Western Tropical Pacific Ocean, as well as the relationship between these and some environmental factors. The results showed that chlorophyll-a contents in the sea area surveyed were represented by a range from 0.01 to 0.39 mg/m^3. Vertical curves of chlorophyll-a were represented by $y = a + bx \mid cx^2 + dx^2$ equation. Maximum values were found at depth of 100 m or 75 m; accidentally higher at 125 m layer. Vertical distribution of phaeopigment are similar to ones of chlorophyll-a while values are lower than chlorophyll-a. Horizontal variations of chlorophyll-a not very obvious according to data sampled from TOGA COARE region to Homiara (Solomon Islands) (157°58'E-160°16'E, 2°15'S-7°00'S) and Guam (158° 15'E-145° 01'E, 2°15'S-12°00'N). Daily and vertical changes of chlorophyll-a were closely correlated with sea current and some physical and chemical factors in the sea water. Their correlation models were established by statistical methods and discussed in detail and they would be helpful for researching ecosystem, water structure and the interaction between ocean and atmospheric in Tropical Pacific Ocean.

IMPACT OF CLIMATE CHANGE ON COASTAL RESOURCES AND ENVIRONMENT AT SURAT THANI PROVINCE, ON THE EAST COAST OF SOUTHERN THAILAND

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The yearly meteorological data (rainfall, air temperature, number of days with thunderstorm, frequency of tropical storm passing Thailand), from 1951 to 1992; the yearly mean sea-level data from 1941 to 1992; Tapi River discharge from 1970 to 1992 and fishery statistics from 1963 to 1991 were analyzed using time series analyses with smoothing and forecast techniques. The climate of Surat Thani Province on the cast coast of Southern Thailand has been changed. The rainfall trend is decreasing by -8.524 mm/year. The air temperature is increasing by 0.037°C/year. Both number of days with thunderstorm and frequency of tropical storms are decreasing. The yearly mean sea-level shows the decreasing trend with similar magnitude of fluctuation than the former years. The Tapi River discharge also shows the decreasing trend. The marine animal catches and aquaculture show rising trend. During the ENSO years, they are the years of relatively low rainfall, high air temperature, low yearly mean sea-level and low river discharge. The impact of rainfall on total marine animal landing shows not very high correlation, but they correlated very well with marine fish catches. For freshwater and aquaculture activities, the rainfall data did not correlate with the freshwater animal production.

A STRUCTURAL MEANS TO PROTECT THE COASTAL ZONES AGAINST SEVERE OCEAN DYNAMICS AND CLIMATE CASE STUDY, MALAYSIA

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The state of Terengganu is situated in the north-eastern part of the Peninsular Malaysia. It is fronted by a long shoreline facing the South China Sea, and therefore subjected to severe weathers during monsoon season which generally lasted several months (November to January). The study area, Rantau Petronas Complex Kerteh, in the state of Terengganu, was reclaimed from the sea and located along this highly dynamic coastal region of the country. In November 1989, the unfortunate coincidence of an extreme high tide and strong storms had washed away beaches at many places along the coastline of the Complex, and one particular site within the Complex was badly affected.

Following the November 1989 incident, the owner of the Complex - The National Oil Company of Malaysia (Petronas) - had given the approval to proceed with the investigation, planning, design and construction of suitable beach protection or preservation system to protect the Complex against further serious coastal erosion.

During the investigation and planning stage, four types of shoreline protection systems were considered, viz. beach nourishment, revetment and beach nourishment, groynes and beach nourishment, and offshore breakwaters and beach nourishment.

SEA LEVEL TRENDS AND CONSEQUENT IMPACT ON SHORELINE CHANGES

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Sediment supply and preexisting shoreline morphology are crucial factors in controlling coastal changes due to sea level changes. Sea level is one of the principal determinants of shoreline position. Sea level rise induces or accelerates on going shore retreat since deeper water decreases wave refraction, thus increasing littoral drift, and also allowing waves to arrive closer to shore before breaking. On the other hand with a tidal variation the position of wave action migrates continuously and a wide stretch of beach thereby comes under the action of waves. The tidal variations make it considerably more difficult to study sediment distribution on the beach or beach profile configuration. There is little information on the effects of the seasonal variation of sea level on the beach profiles.

The sea levels have been obtained from the records of the tide gauge installed at the port. The annual mean sea levels for each year have been evaluated. Data on shoreline changes have been obtained from the marine department of the Port Trust. The offshore bottom profiles have been considered for the study of sedimentation in nearshore waters. The annual variations or mean sea levels are obtained from the average of the monthly mean sea levels. The annual mean sea levels indicate a small variation from the mean. It does not shown any positive or negative trends. Any permanent trend can be ascertained with the precise leveling of the coast from time to time. The small oscillator nature of mean sea level man be due to the changes in the mean climatic conditions

or the station. To account for the annual cycles of sea level, the atmospheric pressure difference, wind speed and direction, rainfall and density of the water should be considered. Aside from astronomical influences it is reasonable to postulate the changes in mean sea level.

WATER MASSES OF THE INDONESIAN SEAS THROUGHFLOW

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Thermohaline fluxes associated with Pacific to the Indian Ocean throughflow coupled with tidal current enhanced vertical mixing within the Indonesian Seas significantly influences the heat, salinity and nutrient budgets of Indonesian Seas and of the larger scale budgets of the Pacific and Indian Oceans. These horizontal and vertical fluxes are an important part of the large scale climate system and influences the environmental conditions of the Indonesian Seas. An extensive suite of CTD stations were obtained from the Baruna Java I during the southeast monsoon of 1993 (6 August to 12 September) and northwest monsoon of 1994 (25 January to 3 March), as part of the Indonesian/US Arlindo project. "Arlindo" is an acronym for Arus Lintas Indonen, which means throughflow. The main objective of these cruises is to determine sources, pathways and mixing histories of the throughflow water masses for the monsoon extremes.

The active throughflow layer as defined by the Pacific to Indian pressure gradient is confined to the upper 200-300 meters, within the rather intense thermocline. Density driven, sill depth overflow into the deep basins, as that of the Banda Sea contribute a minor amount to the total throughflow. Water masses analysis indicates that the Makassar Strait carries the bulk of the Pacific to Indian throughflow. Even in the expected maximum throughflow period of the southeast monsoon there is only minor contribution within the potential throughflow pathway east of Sulawesi. The Makassar throughflow consists of North Pacific Subtropical Water (s-max core near 20°C and 100 meters) and North Pacific Intermediate Water (s-min core near the 10°C isotherm at 300 meters). During the northwest monsoon the throughflow appears to slacken significantly as a higher degree of attenuation of the core layer stratification is observed within Makassar Strait. This suggest longer resident times, i.e. reduced throughflow. While some of the throughflow has been shown to pass through the Lombok Strait,?

WATER MASS DISTRIBUTION ON ISOPYCNALS IN THE INDONESIAN SEAS

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Salinity and dissolved oxygen from historical hydrographic data are examined on isopycnals for consistency with an hypothesis of isophycnal spreading and mixing of North and South Pacific sources through the Indonesian Seas. Dissolved oxygen proves problematic as a conservative tracer inside the Indonesian archipelago due to strong consumption in the upwelling regime of the Arafura Sea, and the subsequent spreading of relatively low oxygen water over a broad area. Based on salinity, three regimes are identified; 1) the surface layer ($\sigma\ \theta < 25.75$, upper 200 m) where characteristics must be dispycnally modified by vertical mixing of excess surface precipitation and runoff, 2) the main thermocline ($25.75 < \sigma\ \theta < 27.0$, 200-500 m) where the data are consistent with

a simple isophycnal distribution of North and South Pacific source types and 3) the deep layers ($\sigma\theta > 27.0$, 500 m to bottom) where diapycnal processes are again required to explain the distribution of water mass characteristics. The make up of the main thermocline in the central Banda Sea shows a decrease in the contribution of the North Pacific with depth.

WATER MASSES STUDY OF THE JADE 1992 EXPERIMENT THROUGH HYDROLOGICAL DATA AND FREONS MEASUREMENTS

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The dense 1992 hydrographic, F11 and F12 data set obtained between Australia and Bali and on the sills between Flores, Sumba, Sawu, Roti and the Australian continental shelf, allow to examine the water masses distribution and their inferred circulation. The sharp hydrological front between the Indonesian waters and the southern Indian ocean waters is found at 13°30S. The front reaches the surface, separating the high salinity surface waters in the south ($S > 35.0$) from the lower salinity surface waters coming from the Indonesian seas in the north. In the study of the subtropical and central water masses, biological oxygen consumption and mixing processes between eastward and westward flows are identified and discussed.

In the north, intrusions of low salinity water from the Java sea, through Lombok strait, were very active in the upper 100 m. At depth, the intermediate North Indian ocean water, trapped along the Indonesian coast, which brings salty, low oxygen and low freons water, enters the Sawu sea through the Sumba strait. Above the sills, freons concentrations are everywhere higher than in the Indian ocean at the same level due to Banda sea tracer enrichment at depth. Thus, freons add a useful information to trace the westward flow. Deep waters study in the Lombok Basin shows a great spatial variability of water masses characteristics due to variable intrusions of north-west salty water and westward input from the sills.

TIDAL MIXING IN THE INDONESIAN SEAS

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Enhanced vertical mixing presumably fueled by tidal mixing is needed to describe the change in vertical gradients within the Indonesian Seas.Temperature signatures of tidal mixing are found throughout the Indonesian Seas on the shallow shelves over sills in straits in the thermocline and at the sea surface. The signatures vary over the semi diurnal, diurnal fortnightly, and monthly tidal cycles. Overall they demonstrate the link between tides and mixing in the Indonesian Seas. ARLINDO Mixing data reveal the presence of thermohaline steps up to 70 meters high in the Makassar Strait most likely associated with internal tides emanating from the abundant shelfslope boundaries. Energetic thermocline movement up to 90 meters vertical displacement over the semi diurnal tidal cycle is observed in the Lifamatola Sill and Banda Sea. Tidal mixing may be exceptionally large in the eastern seas contributing to the dramatic change in vertical gradients found within the Banda Sea thermocline relative to other Indonesian Seas.

Coupling of tides and vertical mixing within the ocean suggests that the vertical flux of ocean properties varies with the vigor of the tides. One such consequence is tidal mixing may affect the sea surface temperature (SST) by mixing colder water up to the surface and when tides are stronger and therefore tidal mixing is stronger the SST may be colder than usual. Evidence of SST changes in the eastern Indonesian Seas at the fortnightly and monthly tidal cycles are observed in satellite data. These small variations in equatorial SST can produce large ocean-atmosphere heat fluxes due to sensitivity of the sensible and latent heat terms to high SST. A time series constructed from the tidal equations predicts years of enhanced and reduced tidal mixing. The possible oceanic and atmospheric responses to these variations demonstrate that the dynamical processes driving tidal mixing in the Indonesian Seas must be adequately parameterizes in climate studies.

TIDAL CURRENT IN THE INDONESIAN SEAS AND ITS EFFECT ON THE TRANSPORT AND MIXING PROCESSES

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We have investigated the characteristics of tides and tidal currents in the Indonesian Seas with particular emphasis on the M_2 barotropic component. The calculated harmonic constants of the M_2 tide are in good agreement with those obtained from numerous tide gauge data. The features of the tidal current field are qualitatively similar to those of Wyrtki (1961). The relatively strong tidal currents are found in the Java Sea and in the vicinity of the narrow straits such as the Lombok and Torres Straits. A significant clockwise residual circulation is induced around Seram Island by the topographic tidal-rectification process. In order to examine the role of tidal currents in transport and mixing processes in the Indonesian Seas, we tracked a large number of labeled particles in the calculated velocity field. In the eastern Indonesian Seas, the tidally net southward-transport through the Seram, Molucca, and Halmahera Seas is not negligible compared with the throughflow transport along the eastern route. In the western Indonesian Seas such as the Java Sea and the Makassar Strait, the tidally net transport is much smaller than that of the throughflow along the western route; however, our result suggests that the properties of water passing through this route could be modified by the strong tidal mixing in the shallow western part of the Makassar Strait. This strong tidal mixing may generate the tidal front between shallow and deep regions.

GEOSTROPHIC TRANSPORT SEASONAL VARIABILITY OF THE PACIFIC-INDIAN OCEANS THROUGHFLOW

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For the dynamic balance of the world ocean, the flow through the Indonesian passages is important to quantify Part of the JADE programme was to get hydrographic sections across the throughflow, at the two opposite seasons, in August during the southeast monsoon and in February during the northwest monsoon. Comparison between the water masses distributions in August 89 and February 92 shows that there are some features which persist from one season to the other. The sharp hydrological front between the Indonesian waters and the southern Indian ocean waters is found at the same latitude. During both seasons, the currents are weak south of the front and the

main pathway of the throughflow waters is located north of the front where the current are stronger but vary with latitude.

Some seasonal variability was also detected. In 1989, the westward total throughflow transport had been estimated to 18.6 $\pm$ 7 Sv. In 1992, the appearance of the east-flowing Java coastal current reversed completely the geostrophic surface flow which led to a very small net total transport across the section. These transport evaluations give an extreme range of the total throughflow; the 1989 cruise was carried out during the southeast monsoon and at the end of a La Nina year, when the 1992 cruise took place during the northwest monsoon and during an El Nino event. Thus, the seasonal and interannual effected added up.

SEASONAL VARIATION OF SALINITY IN THE MIXED LAYER OF THE INDONESIAN SEAS

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We have investigated the seasonal salinity variation in the mixed of the Indonesian Seas using the "particle tracking method" as follows; (a) numerous labeled particles are tracked in the velocity field that was obtained by the robust diagnostic GCM with seasonal forcing; (b) we tag salinity to these particles, the values of which are subsequently changed by freshwater flux through sea surface and lateral mixing during particle excursion; (c) the seasonal salinity change in the mixed layer of each basin comprising the Indonesian Seas is obtained by monthly averaging he salinity values of particles located in the upper 50 m of each basin. The seasonal salinity variation in the mixed layer obtained by this method showed similar features to the observed one. Since this method has the advantage that enable to clarify the origins and histories of waters affecting the salinity variation in the mixed layer, a close examination of the particle tracking result revealed the major factors causing the seasonal salinity variation in the Indonesian Seas. In the Banda Sea, for example, the salinity decrease in the mixed layer during the northwesterly monsoon season (from November to March) is primarily due to the excess of precipitation. Note that although there is a significant intrusion of high salinity water from the Indian Ocean, its effect on the salinity change in the Banda Sea is canceled out by the eastward advection of low salinity water from the Flores Sea. In contrast, during the southeasterly monsoon season (from May to September), salinity in the mixed layer increases due to both the southward inflow of saline South Pacific water and the local upwelling probably by monsoonal winds; the upwelling causes that more than 50% of water in the mixed layer of the Banda Sea could be replaced with the deeper water. Evaporation in this season plays a minor role in the salinity increase.

THE TIMOR PASSAGE; ITS CONTRIBUTION TO THE INDO-PACIFIC THROUGHFLOW

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A correct estimation of the annual throughflow between the Pacific and the Indian Ocean remains a first priority for global ocean studies (Gordon, 1986). A hydrographic section between Australia and Bali has been carried out in August 1989 during the first Java Australia Dynamic Experiment (JADE89) and led to a geostrophic estimate (Fieux et al, in press) and some direct

evaluation in the Timor Passage for the period 1989-1990 which stressed the intense low frequency variability (Molcard et al., in press).

During JADE92 the hydrographic section between Australia and Bali was repeated and two current meter moorings were launched from the R.V. Marion Dufresne in march 1992 across the Timor Passage and recovered in April 1993 from the R.V. Baruna Jaya I. The analysis of this data set leads to an estimate of the contribution of the Timor Passage to the throughflow and attempts to test the geostrophic approximation in the passage. Sea level data, at least for the 1989-1990 period, indicated a remarkable correlation between the sea level at Benoa and the upper water transport through the Timor Passage. The low frequency variability noted in 1989 persisted during the 1992-1993 period with an unexpected high south westwards flow between 1200 and 1550 meters. These two measurement periods show significant differences which indicated that strong interannual variability may be expected in the throughflow.

BANDA SEA AND THE INDIAN OCEAN IN THE THROUGHFLOW CIRCULATION

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The compulsory pathway of the throughflow between the Banda sea and the Indian Ocean is either through the Sawu sea, north of Timor, or through the Timor sea, south of Timor. During the JADE experiments in March 1992 and in May 1993 data have been gathered on the sills between Alor, Timor, Flores, Sumba, Sawu, Roti and the Australian continental shelf, and in the Sawu sea and the Timor sea, from the RV Baruna Jaya I and the RV Baruna Jaya I and the RV Marion Dufresne.

The results indicate among others that in the upper layer of less than 22.0 sigma-$^{\Theta}$, strong advection of low salinity, presumably of Jawa sea origin, could reduce the salinity in the Sawu sea from 34.9 psu to around 32.7 psu. This phenomenon is considered exceptional for the Sawu Sea. At mid-depth, aro/und 27.0 sigma-$^{\Theta}$, advection of the immediate North Indian water of salinity 34.68 psu into the Sawu sea is clearly seen only through the Sumba strait. The remnant of this water is still discernible up to the northeast end of the Sawu sea.

SURFACE CURRENT FIELD IN THE TROPICAL INDIAN OCEAN AND THE SEAS ADJACENT TO INDONESIA OBSERVED WITH SURFACE DRIFTERS

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Six to ten surface drifters have been deployed in the tropical Indian ocean every year since 1989 within a research programme "Japanese Experiment on Asian Monsoon (JEXAM)' promoted by Science and Technology Agency of Japan. All the drifters are designed according to the specification recommended by TOGA/WOCE Surface Velocity Programme Planning Committee (SVP).

Thirty-one drifters altogether were deployed by the end of 1993, and most of the tropics of the Indian ocean and the regions adjacent to Indonesia have been covered with their trajectories. The tracks of the drifters and the averaged velocity fields calculated for 2x2 degree grids for each season after screening of erroneous locations for each drifter are described.

An observational evidence that the surface currents around the Indonesian Islands, where the water should be exchanged between the Western Tropical Pacific ocean and the Indian ocean, flow toward the Pacific ocean from the Indian ocean in the boreal winter is derived from the fact that some of the drifters deployed south off Java Island in December 1993 drifted into the marginal seas from the Indian ocean, though no information on the subsurface currents can be taken from the drifters data.

Seasonal change of the current velocity of the North Equatorial Current can be seen in the averaged velocity fields, i.e. westward flows are dominant in the boreal winter while eastward flows in spring. It is observed in the tracks of drifters that switching of the current direction in the interseasonal period occurs in only one week or less, reflecting the quick response of the equatorial ocean to the change of wind direction.

LARGE SCALE SEA LEVEL WIND AND THERMOCLINE VARIATIONS IN THE INDONESIAN THROUGHFLOW REGION

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Historical sea level, wind, and hydrographic observations are used to examine the structure of and relationships between, the large-scale sea level gradients, the wind, and the depth of the thermocline as a function of both time and space. The idea behind the analysis is that fluctuations in the throughflow result from a complex interaction of remote sea level forcing at semiannual frequencies in the Indian Ocean, and annual frequencies in the Pacific Ocean, combined with local wind effects, including coastal upwelling on the southern side of the archipelago and wind-stress curl over the interior Indonesian seas. It is hypothesized that the basins of the archipelago act like a reservoir to fluctuations in the throughflow; if so, sea level and the thermocline depth must change in response to the associated changes in mass in the upper layer. Empirical orthogonal function analysis is employed to identify the spatial and temporal structure of the most energetic components of the different variables.

ANNUAL AND SEMIANNUAL VARIATIONS IN THE EQUATORIAL INDIAN OCEAN; OBSERVATION AND SIMULATION

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Seasonal variations of sea level and temperature records in the equatorial Indian Ocean are compared with results from an improved version of the Indo-Pacific Ocean general circulation model of Masumoto and Yamagata (1993).

Annual and semiannual variations in sea level records from the western coast of Indonesia are simulated reasonably well in the model in both amplitude and phase. The annual component is caused locally by monsoonal winds, whereas the semiannual component is caused remotely during the monsoon transition periods and propagates eastward along the equator and then along the coast, as discussed by Clarke and Liu (1993). The eastward semiannual propagation along the equator is observed well in the 20 degree isotherm depth anomaly record. Along 4° N, however, the propagation direction is westward, which suggest that the quatorial Kelvin wave reflects as the equatorial Rossby wave twice a year at the coast of Sumatera. This phenomenon is also simulated well in the model. The influence of those seasonal variations on the Indonesian Throughflow is discussed as well.

SIMULATED SEASONAL VARIABILITY OF THE INDONESIAN THROUGHFLOW

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Seasonal variability of the depth-integrated transport in the Indonesian Seas and its driving mechanism are investigated in detail by use of an Indo-Pacific Ocean general circulation model that allows the barotropic Indonesian throughflow.

Simulated net throughflow has an annual mean transport 9.5 Sv from the Pacific to the Indian Ocean with a maximum (minimum) transport of 11.6 Sv (6.0 Sv) in August (January), 75% of this transport flows through the Lombok Strait. Comparison with the result of Masumoto and Yamagata (1993), in which the circulation around Australia was not permitted, clarifies that the inter-basin throughflow does not affect the seasonal variations in the transport through the Lombok and the Macassar Straits. The net throughflow, however, affects strongly the seasonal variability of circulation around Halmahera Island. The strength of the New Guinea Coastal Undercurrent is also affected by the existence of the net throughflow.

Additional experiments were carried out by masking winds over particular regions to clarify winds which are actually effective in the variations in the transport through the Lombok Strait is almost perfectly governed by the winds over the equatorial Indian and Pacific Oceans. On the other hand, mid-latitude wind stresses, both over the Indian and the Pacific Oceans, play an important role in the transport through the Timor Sea.

SEASONAL TRANSPORT VARIATIONS IN THE INDONESIAN SEAS

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Seasonal transport variations between the Pacific and Indian Oceans via the Indonesian Seas were studied by the Euler-Lagrangian method. The model well reproduces the features of seasonal variations in the Indonesian Seas. The total volume transport of the Indonesian Throughflow is 20 ± 3Sv, similar to those of previous GCMs with a wide Indonesian passage despite resolution of the presence of the many small islands in the Indonesian Seas. Although a large portion of the net transport is contained in the upper layer, deep transport below 1000 m depth is about 5 Sv. This value corresponds approximately to 25% of the total transport, which means that disregard of the

deep transport leads to underestimation of the volume transport of the Throughflow. Tracking of numerous labeled particles in the calculated velocity field clarifies the sources and pathways of the Indonesian Throughflow. The major route is a western one through both the Makassar and Lombok Straits. Most of the North Pacific water supplied from the Mindanao Current passes along this route, entering the Indian Ocean within several months with almost no loss of its properties. In contrast, South Pacific water intrudes into the eastern Indonesian Seas (i.e., it takes the eastern route), and subsequently mixes with waters from the North Pacific and Indian Oceans in the Banda Sea, which means that there is a long period of travel for South Pacific water (at least a few years). Water taking the eastern route therefore loses its original properties before arriving at the Indian Ocean. The transport processes also are significantly affected by seasonal variations in equatorial circulation in the western Pacific. In the upper layer, for example, North Pacific water is vigorously supplied to the western route only from boreal spring to summer associated with the linkage between the current flowing through the Makassar Strait and the Mindanao Current. In other seasons, because of increase in the linkage between the Mindanao Current and the Equatorial Countercurrent, its upper water flows back to the Pacific Ocean.

EXTRA-TROPICALLY INDUCED VARIATIONS IN THE INDO-PACIFIC THROUGHFLOW, AND CONSEQUENCES FOR THE SOUTHERN-OSCILLATION

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An obvious source of low-frequency variability in the Indo-Pacific Throughflow, (IT) is the partial transmission of equatorial, baroclinic Rossby waves incident on the west Pacific boundary. A multi-level GCM is used to investigate whether low-frequency, baroclinic signals originating in the northern and equatorial Indian Ocean, or extra-tropical Pacific Ocean produce variability in the IT, and if so, the associated spatial and temporal structure. Low-frequency variability in the IT could also be generated by low-frequency signals of barotropic origin interacting with the bottom topography within the Indonesian archipelago. These barotropic signals arise from wind-stress variations across the Pacific to the east of Australia-Papua New Guinea. Runs with wind stresses derived from ECMWF 1000 mb winds for 1985-89 are used to assess the contributions from each source, and their relationship to the timing of the 1986-87 ENSO. The geometry and bottom topography of the Indonesian archipelago is very complex, and difficult to represent accurately in a GCM. The IT response is found to be sensitive to the configuration of the archipelago, primarily due to the magnitude of the JEBAR response induced. The effect of various geographical features of the region separating the Indian and Pacific Oceans at low latitudes on the Throughflow is discussed in the contex of their representation in a GCM.

CHOKED FLOWS FROM THE PACIFIC TO THE INDIAN OCEAN

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We consider two rectangular oceanic basins (each of which contains a light upper layer overlying a slightly heavier deep lower layer) separated by a thin meridional wall. The wall contains a gap which is initially blocked by a gate; westward winds are allowed difference between the basins. The conceptual gate is then removed and the resulting nonlinier flow from the intense western boundary currents in the Pacific basin to the sluggish eastern Indian basin is computed. The final steady state is taken to be analogous to the actual oceanic situation.

The analytical calculations are based on a simple wind-driven general circulation model and a nonlinier integrated momentum constraint. Two classes of nonlinier solutions which are far from a state of geostrophic balance are constructed. One corresponds to a situation where the flow through the gap originates from the right band side (looking upstream) of the inner Pacific basin and the other to a situation where the flow originates from the left hand side. It is suggested that the actual Indonesian throughflow is composed of both of these classes of flows, i.e., the throughflow corresponds to an exchange via two adjacent gaps rather than one gap.

Our computations suggest that approximately 6 Sverdrup enter the passges from the North Pacific and one Sverdrup from the South Pacific giving a total of 5 Sv. These estimate imply that, as the observations suggest, it is a mixture of North and South Pacific water that enters the passages. This may resolve the apparent difficulty associated with existing linier theories (and nonlinier theories that neglect western boundary currents) which predict that, without strong turbulent diffusion, only South Pacific water can enter the passages.

A PROJECT TO PROVIDE MARINE METEOROLOGICAL/OCEANOGRAPHIC SERVICES FOR MARINE ENVIRONMENTAL MANAGERS IN ASEAN COUNTRIES

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Virtually all planning and operational activities in the marine environment, particularly the coastal zone, are influenced by the physical state of the marine atmosphere and the ocean surface layer. Accurate climatological and real-time analyses of this environment, as well as short-term predictions of future conditions, can have a significant impact on the safety of life and property, the protection and management of the marine environment and the economics of marine-related engineering, industry and commerce. Examples of such activities where positive impacts are already well-known, and which are relevant to the ASEAN region, include offshore oil exploration and production, marine pollution monitoring and emergency response, fisheries management, aquaculture, shipping management and harbor control and responses to seasonal and long-term climate variations.

The capabilities of ASEAN countries to provide these services are uneven and generally inadequate in term of access to appropriate data bases, modelling and prediction capabilities, and technical expertise. A joint WMO/IOC project will be presented which has been developed to expand these capabilities on a coordinated regional cooperative basis, including use of existing operational facilities for data collection, exchange and processing associated with the ASEAN Specialized Meteorological Centre (ASMC) in Singapore. Specifically the project envisages the enhancement of this existing centre to include a specialized regional marine centre (SEACAMP-South-East Asian Centre for Atmospheric and Marine Products), which will prepare and distribute a variety of operational or quasi-operational regional marine products to associated countries for distribution to marine managers and other users at the national level. Initially envisaged are fine-scale sea-state predictions, SST analyses, ocean surface transport analyses and predictions, analyses of the mixed layer depth and areas of upwelling, and regional sea-levels analyses.

The project will also encompass some enhancement to the existing operational marine observing and ocean data networks, access to operational oceanographic satellite products and near-real-time access to large oceanographic data bases and operational products from outside the region, for use in the preparation of regional products. SEACAMP will have a small permanent staff of specialist scientists from the region and will also be responsible for training additional specialists from participating agencies, which will initially include meteorological and oceanographic services, institutes and agencies from ASEAN countries. This project is seen as contributing directly to the regional implementation of GOOS.

ANNUAL CYCLE OF SURFACE WINDS OVER THE WESTERN PACIFIC OCEAN

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Wind speed measured by the Special Sensor Microwave Imager (SSMI) and wind vector measured by the first European Space Agency (ESA) Earth Remote Sensing (ERS-1) are used to describe the annual cycle of wind speed, wind-stress curl, and wind divergence in the 120°E-180°, 60°S- 60° N region. Monsoonal wind pattern will be described. A relationship between wind divergence, rainfall, and sea surface temperature in the TOGA-COARE area will be discussed.

TRANSPORT OF THE NEW GUINEA COASTAL UNDERCURRENT THROUGH THE VITIAZ STRAIT MARCH '92-APRIL'93

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The equatorial and subtropical circulation in the Southern hemisphere of the western Pacific is constrained by flow through several stratits along the western estimates of the New Guinea Coastal Undercurrent (NGCU) of 8-14 Sv through the Vitiaz Strait with a distinct strong undercurrent (Lindstrom et al., 199). A transport-resolving current meter array was deployed to determine the annual cycle and intra-seasonal variability of the flow of the NGCU through the Vitiaz Strait. The subtidal transport varies from 9 Sv in February up to 20 Sv in May and continues high (15-18 Sv) through the months of the northern summer. While channel depths are 1100 m, 75% of the transport is in the upper 400 m. The lack of a distinct undercurrent is notable in the 1992-93 observations. Significant intra-seasonal band fluctuations are present in the upper level current observations. Events of 4-8 days duration even show low frequency flow reversal. Compression of monthly mean velocity distribution indicates the modest seasonal cycle of + 1.5 Sv appear as a barotropic adjustment throughout the water column. The equatorward flow of Antarctic Intermediate Water of 2-2.5 Sv is in agreement with Tsuchiya"s earlier estimate from WEPOCS data.

Numerical simulations with the NRL global, multi-layer model driven by ECMWF winds are compared to the observations and utilized to examine the variability of the flow field in this complex region. The model grid spacing (.25° in longitude, .37° in latitude) permits resolution of the primary passages for the equatorward western boundary current flow, the Vitiaz Strait, St. George"s Channel and the Solomon Strait. Model experiments yields a mean transport through the Vitiaz Strait of approximately 15 Sv with significant inter-annual, seasonal and intra-seasonal variability. The inter-

annual variability of the 120-year (1981-1993) model output clearly explains the difference in the strength of the undercurrent between the 1985-86 WEPOCS data and the present observations.

A HYDROGRAPHY IN THE SOUTHERN PHILIPPINE SEA : FRORN WOCE HYDROGRAPHIC PROGRAMME SECTION PRIS AND PR24

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Observation of the WHP hydrographic sections PRIS (along 130°E) and PR24 (from SE of Mindanao to Indonesia) was carried out in February 1994 by R/V KAIYO as a joint cruise of JAMSTEC and BPPT. The observation along 6°N (from Palau is to SE of Mindanao) was also executed. As a result of hydrographic analyses, we found the following features in the southern Philippine Sea.

1) High salinity water in the subsurface layer transported from southeast, which might be an extension of New Guinea Coastal Undercurrent, reached 5° N along 130° E and also reached 4° N along the section of PR24. This fact suggests the possibility that the high salinity water originated from the southern Pacific; might be transported into the Indonesian Seas through the Molucca Straight.

2) The homogeneous water is lying below 4,000 dbar in this area. The properties are 27.77 in sigma-theta, 1.243 +/ -0.005 degrees in potential temperature, 150.5 +/- 0.8 umol/kg in dissolved oxygen, 139.8 +/- 1.2 umol//kg in silicate concentration, 36.1 +/- 0.3 umol/kg in nitrate concentration and 2.47 +/- 0.03 umol/kg in phosphate concentration.

3) The saline water with salinity of higher than 34.680 PSS below 4,000 dbar around 4°N and 5°N along the section of PRIS was found. The silicate concentration of this water is relatively smaller than the surrounding waters. Because the waters with the same feature were not found in the section of PR24 and along 6°N this water with high salinity and low silicate concentration might be originated from western Caroline Basin through the sill of the Kyushu-Palau Ridge near 4°N and 5°N.

APPLICATION OF THE OCEAN ACOUSTIC TOMOGRAPHY TO THE MEASUREMENT OF OCEANIC CONDITIONS OFF MINDANAO ISLAND

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An acoustic tomography experiment using a transceiver and a receiver was done during February-June 1992 along the latitudinal line of 10° off Mindanao Island, Philippines where the North Equatorial Current branches into the Kuroshio and the Mindanao Current. The transceiver emitting 400 Hz carrier waves modulated by the M-sequence signal of 9th order was located at 1496 m depth of the station 247 km away from the transceiver. The transmission times for six-eight ray paths were measured successfully over the whole period between the transceiver and receiver. The averaged sound speed in the vertical section of depth range 82-51822 m and horizontal width 247 km was calculated by the inverse analysis which use the transmission times as data.

The averaged sound speed was continuously increased with time after 9 April, showing the successive intrusion of warm water masses into the experimental site. It is suggested that this warm event is part of the ENSO-related phenomenon which took place over the equatorial pacific at the decay of the 1991 El Nino. The subsurface structure of the warm event is now under consideration.

ACOUSTIC MEASUREMENT OF OCEAN CURRENT AVERAGES OVER 10 KM RANGE

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Volume transport and heat transport of the ocean currents are essential for understanding the role of the ocean on climate. However, direct measurement of transport is difficult. We developed a moored system of multi-path IES inverted echo sounders) to measure the transport averaged over about 10 km range. The bottom-mounted IES records travel time of acoustic signal between the sea surface and the bottom. The travel time varies according to depth averaged speed of sound which mainly governed by a change of temperature. When a pair of the IES's is set within a range of acoustic transmission, travel time of sound signal directly from one to the other varies with the current velocity at the moored depth. The sound signal from one IES is also detected by the other after reflection at the sea surface at midway. The travel time varies with the depth averaged current between two IES's. When we use 10kHz waves, the distance between the IES's can be set less than about 20 km. The volume and heat transports of the Kuroshio may be measured directly by using many pairs of IES's.

On 17 June 1993, four sets of IES were moored in the east of Miyakejima Island over the Izu Ridge where the Kuroshio passes from Shikoku Basin to North Pacific Basin. The water depth there was 1200 m. Records from one pair of IES separated 9.23 km were analyzed. Current speed was estimated from difference of travel time from one to other. Obtained current at 1000 m depth for about 56 hours was coincided with those measured with current meters. The depth averages current over 9.23 km showed the tidal current of baroclinic mode was eliminated.

We plan to operate for more than one year from September 1994. The multi-path inverted echo sounder is expected to play an important role in the International Cooperative Research on GOOS, sponsored by the Ministry of Education and Science, Japan.

GEOGRAPHIC LOCATION INFLUENCES CORAL COMPOSITION: A COMPARISON BETWEEN BALI AND SULAWESI, INDONESIA

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The Indonesian archipelago is often perceived as supporting the most diverse coral reefs in the world, yet few studies have been conducted in this region. Coral reefs at three sites in southern Bali, Indonesian are described and compared with coral reefs in southwest of Sulawesi, Indonesia. Comparisons are made using acropporidac the most diverse scleractinian (hard) coral family. Reefs in Bali are heavily impacted by oceanic swells whereas reefs in Sulawesi are sheltered. Both geographic locations supported a similar number of Acroposa and Montipora species (Acroporidae), however composition varied, locations only shared - 60% of species. Species found in southern Bali, and not Sulawesi, were typical of exposed outer reef locations on the Great Barrier Reef, Australia.

Species found in Sulawesi, and not Bali, were more typical of shletered habitats on the Great Barrier Reef. Thus, the physical environment of a geographic location appears to have a strong influence on coral species composition and abundance. This is consistent with resulted from fringing reefs on the Great Barrier Reef.

Since most corals broadcast their gametes, distribution pattern may not be essentially a consequence of inefficient dispersal. Rathor, variation in community composition may be a consequence of selection against some corals after settlement, favouring species adapted to the geographic location. Such affects may be continuous. With anthropogenic disturbances increasing world-wide, especially of fringing reefs, understanding the processes nearshore is essential towards generating policies that will ancliorate these problems. Interpreting disturbances includes understanding regional influences that may over-ride local phenomenon.

INTERNATIONAL FLUCTUATIONS OF THE BIFURCATION OF THE NORTH EQUATORIAL CURRENT IN THE WESTERN PACIFIC

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The mass, heat and fresh water exchanges between the tropical and subtropical gyres in the northern Pacific are strongly determined by two western boundary currents, the southward flowing Mindanao Current (MC) and the northward flowing Kurashio. This is because the westward North Equatorial Current (NEC) supplies water from the interior of the Pacific basin to both boundary currents, and the partitioning of its waters into these boundary currents is variable. An aspect of this variability is the latitude of the NEC bifurcation. Using the high resolution version of the multi-level Parallel Ocean Climate Model (POCM) of Semtner and Chervin (1988), fluctuations of the bifurcation latitude of the NEC have been studied. Model results, from experiments forced by winds based on three-day ECMWF data, are analyzed from 1986 through 1989. Preliminary analysis shows that the bifurcation latitude, expressed as zero meridional flow in the top 360 metres, reaches a southern extreme of 12N in the spring of 1989 and a northern extreme of 18N in the summer of 1987. Model results show biannual variability dominates seasonal.

Validation of the model velocity field, due to a lack of observations, is not possible; comparison of model sea level with available observations will be discussed, along with the correlation between model upper ocean velocity and transport and model sea level. The model will then be used to relate the relative roles and interactions of the seasonal and interannual fluctuations of the Strengths and weaknesses of applying this model to the western equatorial Pacific will also be discussed.

ON THE SEASONAL AND INTERANNUAL BIFURCATION OF THE NORTH EQUATORIAL CURRENT ALONG THE PACIFIC WESTERN BOUNDARY

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After encountering the western boundary along the Philippine coast, the North Equatorial Current (NEC) bifurcates into the northward-flowing Kuroshio and the southward-flowing Mindanao Current. Clarifying the variability of the NEC's bifurcation is important to our

understanding of the mass, heat, and salt exchanges across the tropical and subtropical circulations in the North Pacific Ocean. The principal external forcing for the changes in the bifurcation is the surface wind. In addition to the basin-scale seasonal migration of the zero-wind-stress-curl line which shifts from 12°N in winter to 20°N in summer, the annual, as well as the regional monsoonal wind fluctuations can exert a significant impact upon the NEC's bifurcation. This study uses a high-resolution, reduced-gravity PE model to study the mechanisms and the consequences of the NEC's bifurcation. Driven by the FSU monthly wind stress data from 1961 to 1992, the model shows that the bifurcation of the NEC occurs at the northern most position in February. The swifter southward migration (than the northward migration) is due to the extension of subharmonics of the annual Roosby waves. On the interannual time scale, the positive wind stress curl of the trade wind tends to intensify and shifts the zero-wind-stress-curl line northward prior to ENSO events. With a lag of about 1 year, this shift induces the bifurcation of the NEC to occur at a higher latitude. No significant seasonal fluctuations are found in the transport of the NEC near the Mindanao coast. This is because the seasonally wind-driven transports of the Kuroshio and the Mindanao Current are out of phase, due to the different phase speed on the baroclinic Rossby waves at their respective latitudes. Further analyses on the interannual changes of the NEC's transport and its partion among the Kuroshio and the Mindanao Current are being made now and will be presented at the meeting.

ANNUAL MEAN HEAT BUDGET AND THE ROLE OF CIRCULATION IN THE TROPICAL WESTERN PACIFIC OCEAN IN GLOBAL GCM

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The world's climate seems to be particularly sensitive to the small changes of sea surface temperature in the tropical western Pacific Ocean. However, studies on surface heat budget are not possible with observations, because the necessary data are not ordinarily available in this region. One possible way is to validate a high-resolution general circulation model (GCM) and then to examine the heat budget in the model quantitatively. Although the model results may not be especially realistic, they at least help us understand how ocean dynamics works in the surface thermal structure and give us useful hints for future observations and studies.

This study describes the large scale aspects of annual mean heat budget and the role of circulation in the tropical western Pacific Ocean, using a seasonal ocean GCM run by Semtner and Chervin (1988, 1992) combined with existing observations. An assessment of the annual mean heat budget of the upper 100 m in the region 20°S-20°N, 10°E-160°E (called the whole region below) shows that the surface heat flux of order 10 W/m^2 in the model is largely transported downward to the deeper levels by vertical motion and mixing; horizontal currents do not play a significant role directly by advection due to small horizontal temperature gradients. These results are fairly consistent with earlier studies (e.g., Niiler and Stevenson, 1982; Godfrey et al., 1991). But on close inspection of smaller areas, with the whole region further partitioned into six parts, we found different mechanisms are balancing the surface heat budget in different areas. In addition to surface heat flux, ocean circulation can also play a major role in the surface heat budget.

Another fundamental result in this study is the convergence of upper-layer warm water in the equatorial region mainly by the equatorward western boundary currents. This may partly explain why the SST maximum (>28°C) exists and give independent evidence for Wyrtki's (Wyrtki, 1985,

1987; Lukas, 1988; Webster and Lukas, 1992) hypothesis of heat accumulation in the tropical western Pacific. The convergence of heat in the upper 100 m of the North Equatorial Countercurrent (NECC) region, for example, is equivalent to a surface heat flux of 17 W/m^2 into the ocean about 5W/m^2 larger than the rate of air-sea exchange of heat in the model. The convergent currents in the region are believed to play a key role in the maintenance of the western Pacific warm pool.

NUMERICAL SIMULATION OF THERMAL AND WIND DRIVEN TROPICAL PACIFIC OCEAN

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Oberhuber's isopunal coordinate ocean general circulation model is studied for the upper tropical Pacific Ocean. The model is driven by monthly mean heat fluxes (COADS data except sea surface temperature (SST) which is predicted from model) and Hellerman & Rosenstein wind stress for 75 years. The spatial means of annual and monthly mean SST differences between model and COADS data are less than 0.6°C in the region from 20S to 20N. However, locally large difference (over 1.5°C) is found in eastern equatorial area in summer season. Seasonal changes of SST, mixed layer depth, and ocean-currents were fairly well simulated.

Vertical profiles in several key sections of temperature and salinity in the upper ocean were compared with both Levitus data and other high quality data observed in recent decades. Good agreements were shown from those comparisons.

A salinity front located near western equatorial area was detected all the year round. This front is sharpest in the third layer (about 200m) of our experiment where a high salinity core is sandwiched by the second layer and the fourth layer. This high salinity core is advected north-westward by the New Guinea Coastal Undercurrent, but the eastward Equatorial Undercurrent prevents this northward intrusion and locks it near the equator. Finally a salinity front is developed there.

A COUPLED TOGA MODEL

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Hadley Centre for Climate Prediction and Research, - Meteorological Office, U.K.

A TOGA couple general circulation model is being used at the Hadley Centre for ENSO related studies. The atmosphere component is the standard 2.5" x 3.75°, 19 level climate model which includes comprehensive physics packages. The ocean is a 16 level version of the COX/GFDL model with a domain limited to the tropical Pacific region. The horizontal grid is of variable resolution with a meridional spacing of 1/3° at the equator increasing to 1° at the open boundaries at 30° N and 30° S. Zonally the spacing is 1.5° over most of the ocean decreasing to 0.5° close to the closed eastern and western boundaries. Outside the ocean domain the atmosphere is forces with climatological sea surface temperatures. Flux correction techniques are not used. A 25 year integration has been made to establish the model climatology.

The model shows substantial interannual variability on timescales associated with ENSO with irregular oscillations which appear to be phase locked to the model seasonal cycle. SST variability in largest in the central Pacific with anomalies showing a tendency to propagate eastward. Analysis of upper ocean heat content shows a marked eastward climatological values but are overestimated towards the east. The resultant east-west temperature gradient is weak and is accompanied by light easterly grade winds along the equator. Temperatures are particularly high in the vicinity of the Peruvian coast and the intertropical convergence zone migrates south of the equator during the northern hemisphere spring.

An interesting aspect of the simulation is the ability of the model to produce westerly wind burts in the western/central Pacific. This and other features of the model will be discussed with particular reference to the simulation in the west Pacific.

ENSO AND THE SEA LEVEL SIGNAL

Wattana Kanbua
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An event when sea-surface temperatures are high and surface pressure difference across the equatorial Pacific is low referred to as El Nino-Southern Oscillation (ENSO). It occurs at irregular interval of 3 years. It coincides with the southern summer, the season of weak southeast trade winds. The ENSO phenomenon is the most notable example of interannual climate variability. Major of the tropics, bringing drought to vast areas and torrential rains to otherwise dry regions.

The effects of El Nino are felt worldwide. In the El Nino of 1982-1983, the most severe of modern times, there were extensive droughts and brush fires in Australia (the worst in 1230 years) along with droughts in Indonesia and north-eastern Brazil. Rainfall was extremely heavy along equator which caused flooding in the normally dry islands. The effects of El Nino were quite noticeable in North America. There were heavy rains in Southern California, and unusually severe storms waves repeatedly destroyed coastal highways.

An El Nino in 1972 (combined with overfishing) resulted in the destruction of the world's largest fishery for anchovy off Peru. Since this fish was widely used for protein supplements for chicken and cattle, its loss resulted in marked increases in the prices for protein. This in turn resulted permanent shifts in the growing of certain crops, such as soybeans, also used for protein supplements.

El Nino also affect the severity of winter weather in the interior of Canada and in the south-eastern portion of the United Stated. The ability to detect the onset of the southern oscillation that causes El Nino now permits scientists to predict the unusual weather conditions up to 9 month ahead of the event.

Nowdays, I have done some project which data from measuring by TOPEX/POSEIDON satellite. It has used the technique of radar altimetry to make precise measurement of sea level with a primary goal of studying the global ocean circulation. WMO shall serve as the executing agency with the responsibility of ensuring the efficient and successful implementation of the Development of Marine meteorology. Thai Meteorological Department shall carry out the operational activities that are necessary for the fulfillment of the project objectives.

ENSO VARIATIONS AND DROUGHT OCCURRENCE IN INDONESIA AND THE PHILIPPINES

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The "El Nino Southern Oscillation" (ENSO) consists of a sympathetic movement involving the Pacific ocean and associated atmosphere in an essentially chaotic manner along the equator. The system oscillates between extremes of so called "warm events" usually lasting one or two years and involving movement of warm sea water from the western Pacific along the equator to impact on the west coast of the American continent and "cold events" associated with easterly trade-wind induced flows of colder water from the eastern Pacific towards the west.

Information drawn from meteorological records in southeast Asia clearly indicates that each event is unique in terms of the signature which it imposes on the rainfall and temperature from location to location. Never-the-less, a strong underlying pattern within the context of each event, itself apparently initiated or molded by the character of the preceding years, can be detected. This pattern permits relatively circumscribed predictions of forward conditions (drought-intensity) for 2 to 3 years, to he made once the event "locks in" for the duration of the warm event and at least one year beyond. The character of the intervening non-ENSO years can also be projected but in a more tenuous, though fairly regular manner.

When the non-ENSO years leading up to a warm event are scored in terms of the extent to which they depart from the secular warming trend for the warmest month using data from Jakarta and Semarang, on the north coast of Java, the cumulative temperature deviations signal the character of the upcoming ENSO event. This signal does not however, allow an exact determination to be made with respect to whether or not an ENSO event will occur in the next year. For the available historical instrumental data, all markedly upward-moving traces eventually delivered a hot dry season in east Indonesia. This sort of tendency within non-ENSO blocks can thus serve as a caution in the sense that a very hot ENSO event is likely in the offing. The background data can also be used to actually predict the probable intensity of an ENSO in the upcoming year in terms of its drought potential, should such an event take place in reality. In this respect the correlation between the cumulative temperature deviation of the inter-ENSO blocks in relation to the temperature deviation of the first ENSO year is 0.43.

In the region of southeast Asia represented by Indonesia and the Philippines, relatively secure predictions concerning likely upcoming droughts can be made in specific instances once an ENSO event "locks in" for successive years (24) until the warm event set terminates. In the case of Java and within succeeding inter-ENSO years, further predictions can be made with reference to successive years in terms of the character of preceding years. This system, in conjunction with predictions generated by models could form the basis of a crop advisory service for prediction of drought or rainfall within dry seasons from one year to the next. It is anticipated that a broad description of temperature and rainfall patterns associated with space and time with ENSO events will lead to better food security for the region as long as sudden changes do not occur.

THE TELECONNECTION BETWEEN EQUATORIAL PACIFIC SEA-SURFACE TEMPERATURES AND CONVECTION OVER INDONESIA DURING ENSO

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The interannual variability of convection over the Indonesian archipelago associated with ENSO events is investigated through the teleconnection between the equatorial Pacific sea-surface temperature anomalies (ssta) and the tropical Outgoing Longwave Radiation anomalies (OLRA) from 1974 to 1993. The compilation of OLR data provides a useful measure of tropical convection for the purposes of climate diagnostics, because of its length and continuity of record. The simultaneous correlations result from the Empirical Orthogonal Function (EOF) and Canonical Correlation Analysis (CCA) show that warm sea-surface temperatures in the eastern equatorial Pacific induce an eastward shift of the Indonesian convection towards the central Pacific. The reduced convective activity over Indonesia was most pronounced within period of July(O) to April(+1) during ENSO events of 1982-83 and 1941-1992. Meanwhile in 1986-1987 ENSO event this feature occurred from September(O) to August (+1). (O) is the year in which anomalously ssta first appears and (+) refers to the subsequent year.

IMPACTS OF THE WESTERN PACIFIC WARM POOL ON THE EAST ASIAN SUMMER MONSOON

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In this paper, the impacts of the thermal state in the western Pacific warm pool and the convective activities around the Philippines on the interannual variation of the summer monsoon in East Asia are analysed by the observed data including the SST and ST in the subsurface layer of the warm pool, the OLR and the precipitation in East Asia. The analysed results show as follows:

1. When the thermal state of the western Pacific warm pool is above normal, ie.,thewarm sea water is accumulated in the warm pool, in this case, the convective activities are intensified from the Indo-China Peninsula to the area around thePhilippines, the western Pacific subtropical high may shift unusually northward. Thus, the East Asian summer monsoon rainfall may be below normal.

2. When the thermal state in the western Pacific warm pool is below normal, i.e., warm sea water extends eastward from the warm pool along the equatorial western Pacific, in this case, the convective activities is weak around the Philippines and are intensified over the equatorial central Pacific near the dateline, the western Pacific subtropical high may shift southward. Thus, the East Asian summer monsoon rainfall may be above normal.

The impacts of the thermal state in the warm pool and the convective activities around the Philippines on the summer monsoon in East Asia are discussed by using the dynamical theory of planetary wave propagation and are simulated by sing the IAP-GCM, respectively.

MODELLING OF THE EFFECTS OF SSTA IN THE TROPICAL ATLANTIC ON THE BLOCKING HIGH AND THE WINTER MONSOON IN EAST ASIA

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It is known that the blocking highs have great influence on the winter monsoon surge. The sea surface temperature anomalies in the tropical Atlantic affect the extratropical circulation. By the use of IAP 2-level general circulation model, a blocking high over the North Pacific is simulated after a warming SST is given at the tropical Atlantic. The simulated results shown that the disturbances, which are caused by the SSTA, propagate northward to the mid-high latitudes by the quasi-stationary planetary waves, and are strengthened in the process of the propagation. When the disturbances reach to the mid-high latitudes, they will cause immediately the disturbance pattern which is distributed over the whole extratropical zone. The disturbance pattern presents a wave-like (wavenumber 3 or 4) appearance along the latitudinal direction, and shows a tendency to move slowly westward, while along the longitudinal direction, positive anomalies alternate with negative ones. By the aid of the disturbance pattern in the mid-high latitudes, a blocking high is initiated over the Alaska Gulf, then moves gradually to the area over Okhotsk Sea, and finally collapsed. It shows that the SSTA in the tropical Atlantic influences the extratropical circulation through the disturbance pattern in the mid-high latitudes, and plays an important role in the blocking episodes.

DATABASE OCEANOGRAPHY ; SEASONAL VARIATIONS IN THE HYPERTROPHY OF THE SOUTH CHINA SEA

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In the last decade many coastal nations turn to the sea for their source of food, energy and power generation. Ocean data are required for these activities and many other activities pertaining to the sea. Technological advances has enable ocean data to be copied onto CD-ROMs and used by scientist for regional studies. This study capitalizes on the NODC data obtained between 1900 to 1990.

Temperature and salinity values from selected standard depths were analysed in different seasons and its distributions were presented as maps. T-S profiles of five selected areas were averaged seasonally and the variation of water masses were analysed. The upwelling of cold water off the Vietnamese coast during summer and the effect of the cyclonic gyre, thought to characterize the deep central part, were also studied.

The result shows that the oceanographic environment of the South China Sea is greatly influenced by the monsoons. The cyclonic gyre in the deep central part of the South China sea caused the thermocline to be uplifted. Surface temperature is higher during the southwest monsoon. In the southern part strong seasonal variation of the upper shallow layers exist. Below 200 m, the seawater properties is less variable. Intrusion from the Pacific Ocean between 100 m and 200 m, and at 500 m during northeast monsoon were also observed. Runoff from rivers in the region reduces the salinity in the Gulf of Thailand. Regions of upwelling were also identified in the study.

CIRCULATION IN THE SOUTH CHINA SEA THE OBSERVATION AND SIMULATION

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Main features of bimonthly circulations in the South China Sea (SCS) are investigated for the first time using observations for the period 1959 to 1983 and a high-resolution oceanic general circulation model forced by the mean climatological wind stress. Bimonthly circulations from surface to 400 m depth are derived from bimonthly patterns of long-term mean of water temperatures on 0,100 and 400 m depth surfaces and the dynamic height relative to 400 db. From November to February circulations in the SCS is mainly dominated by the SCS cyclonic gyre, but by the anticyclonic circulation in the southern region below 200 m depth. From May to August circulations in the northern region and off the coast of Vietnam are mainly dominated by cyclonic circulations, and circulations in most of the southern region are dominated by anticyclonic circulations. In March-April and September-October circulation patterns show great resemble in the SCS except in the western region. The mesoscale anticyclonic circulation there in March-April is replaced by the cyclonic circulation. Therefore most of circulations in the South China Sea are not permanent except the mesoscale cyclonic circulation in the northern SCS. Both observed and simulated temperatures and circulations are very sensitive to the Asian Monsoon. Features of the simulated circulation are in agreement with the observations. The strong current off the coast of Vietnam is discussed for the first time in detail based on the simulation. Some differences between the observed and simulated circulation are also discussed.

NUMERICAL MODELLING OF CURRENT DYNAMICS AND LOW-FREQUENCY OSCILLATIONS IN THE SOUTH CHINA SEA

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The low frequency variability of the sea surface temperature)SST) with periods of several years was established in the South China Sea (SCS) area and in the west Pacific Ocean by the intensive Chinese study of recent years.

Integrated numerical model was used to analize low frequency oscillations of hydrophysical fields in the SCS. The model is based on several simple models. Each of these models deals with the special tipes of experimental and simulated data. The main idea is to use this integrated model instead of a complicated one.

The dynamics of currents in the SCS has been investigated using the diagnostical part of the model and several nonlinier parts, based both on the vorticity equation and on shallow water ones. It was shown that the influence of a deep water movement and exchanges through the straits on the upper circulation is negligible and the bottom topography does not play and important role.

Finally it was used an eddy resolving barotropic model of the SCS without topography and inflow through the straits to simulate the low frequency oscillations of the sea surface temperature SST and sea-atmosphere heat and impulse exchanges. The local action of the storms and the barotrophic instability were modelled with the stochastic representation of the external force.

The regime with long-period oscillations (2.5 and 1.3 years) of the SST was obtained. The were not connected with the mean circulation. It was found that the frequency of these self oscillations depends on the latitude. It is possible to conclude that the nature of this phenomenon is not the peculiarity only of this region, but every basin has its own low frequency of oscillation.

NUMERICAL STUDY ON THE INTERRELATION BETWEEN THE KUROSHIO AND THE CURRENT OF THE NORTHERN SOUTHERN CHINA SEA

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The South China Sea (SCS) and the Pacific Ocean are connected by the Bashi Channel (BC) between Luzon and Taiwan Islands. The strong Kuroshio flows northward along the coasts in the regions east of Luzon and Taiwan. The questions such as: "How does the Kuroshio move in BC? What relationship between the Kuroshio and the current of the northern SCS exist?" have attracted many oceanographer's attention both at home and abroad. However, studies on the current status in BC were carried out mostly by analyzing historical hydrographic data, dynamic calculations, or using the data derived from shipdrifts due to lack of current measurements. So far, whether or not there exists a branch of the Kuroshio entering SCS or Taiwan Strait through BC is still a controversial issue. In this paper the results of a numerical study are analysed which show that; in BC south of 20°N, some water of the Kuroshio enters SCS all the year round, a part of the water moves anticyclonicly and comes back into the Kuroshio again along the south end of Taiwan; another part seems to flow westward together with the north flank of the cyclonic eddy in the northern SCS, sometimes it can reach the inner area of SCS. In June, there is no cyclonic eddy in the northern SCS, the water entering SCS in the southern BC only flows anticyclonicly and feeds into the Pacific in the northern BC, the flow moving westward is not visible. Apart from the caces in September and October, there is always a ridge of high pressure corresponding to the high elevation of the sea surface during other months which stretches into SCS through BC. Some water flows along the isopleth of pressure ridge, so the part presents an anticyclonic meander. In September and October, the pressure ridge do not spread into SCS, there is also no flow moving anticyclonicly. The water of the Kuroshio entering SCS in the southern BC flows westward to the region east of Hainan Islands, and then feeds into a southward coastal current. The results of the numerical study also show that no direct branch of the Kuroshio flows northward into the Taiwan Strait along the southwest coast of Taiwan.

THE JAPAN SEA DYNAMICS INFERRED FROM NOAA AVHRR INFRARED IMAGES

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This manuscript focuses in studies of surface circulation in the Japan sea in autumn 1993 after the CREAM'93 observational cruise. A series of satellite infrared images was acquired and processed to provide a thorough view on the Japan sea dynamics. The satellite data were HRPT (High Resolution Picture Transmission) AVHRR (Advanced Very High Resolution Radiometer) images from the U.S. NOAA polar orbiting satellites. The data were received with TeraScan HRPT Antenna server. Radiometric calibration and map projection transform were implemented to get the sea surface temperature (SST) data on the regular 1.1 km grid. The SST images were conventionally

processed with MCSST method for atmospheric absorption correction. The corrected images were processed with orthonormal wavelet technique. The wavelet decoding-encoding transform allowed better representation of the sea fronts, eddies, and streamers that appeared in the SST patterns.

Several new features of the Japan sea circulation were observed in the subpolar front and the northern Japan sea. The subpolar front had apparent double frontal structure. The mesoscale cyclonic and anticyclonic eddies were connected in chains in the eastern part of the frontal zone. These frontal instabilities can be generated due to response of the sea localized buoyancy forcing of potential vorticity due to the outflow through the Tsugaru strait from the Japan sea. A southwestward Liman cold current with attached shear-layer eddies was found 5-60 km offshore of the Siberia and Korea coast. The autumn upwelling near the Siberia coast lead to development of the local and extremely cold (SST = 3°C) area between the subpolar front and the Siberia coast at 132-133°E as early as a the end of October.

This area could be a place of a deep convection in winter.

SOME FEATURES OF WINTER CONVECTION IN THE JAPAN SEA

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Historical Russian data provide indication of winter convection reaching down to about 1000 m depth near Vladivostok. However, this kind of convection does not occur every winter. Further data analysis suggests that the location of convection is driven offshore by the coastal buoyant water, which otherwise would be the coastal area. The coastal buoyant water is mostly cold fresh water but occasionally warm coastal water in the south. Due to the large extent of fresh coastal water in the northern part of the basin, the convection does not happen in this area despite the most intensive surface cooling.

ROBUST DIAGNOSTIC MODELLING OF THE JAPAN SEA CIRCULATION

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By using the robust diagnostic model with the data from JODC and Russia, we studied the seasonal variation of the Japan Sea circulation. The results reproduce measure features of the japan Sea circulation; 1) large cyclonic circulation north of the polar front in the upper layer, 2) the Tsushima current branching in the surface layer south of the polar front 3) subsurface southward counter current along Korean coast 4) subsurface westward counter current along Japanese coast, 5) the vertical meridional circulation with upward motion in the south and downward motion developing down to 2000 m. The strong seasonal variations of wind and heat flux through the sea surface induce the interesting seasonal changes to the measure features of the circulation mentioned above.

FIELD TEST OF A TOWED VEHICLE "FLYING FISH" DEVELOPED FOR PHYSICAL AND CHEMICAL MEASUREMENT IN THE OCEAN UPPER MIXED LAYER

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For long range climate forecast knowledge of the heat, momentum and substance exchange between the atmosphere and the ocean is essential because the time constants and capacity of the ocean are much larger than those of the atmosphere. For example the exchange rate of CO_2 between the atmosphere and the ocean is therefore of great importance.

Variations in the physical and chemical properties of the ocean, especially in the upper mixed layer where ocean atmospheric interaction is very active, should be researched in detail. Many kinds of hydrodynamic phenomena such as currents, wave motions, fronts and vortices in various time-space scales exist in the ocean as they do in the atmosphere. Dissolved substances in seawater are transported, diffused, and sometimes condensed by the effects of these physical phenomena. Observations of both physical and chemical properties at the same time are therefore essential but are difficult to achieve with existing methods because of restrictions on ship time.

This motivated development of the high speed towed vehicle for physical and chemical measurements. It enables us to measure the current, temperature, salinity, dissolved carbonate and oxygen, turbidity, chlorophyll and pH of the seawater in real time as the mother ship moves along at high speed. We named the towed vehicle "FLYING FISH" because it was developed for research on the ocean-atmosphere interference. The results of field test carried out in the CREAM'S 94 will presented.

ANNEX III

Speech at the Opening of the Sympodium
by Prof. Dr.-Ing. Wardiman Djojonegoro
Minister of Education and Culture
Republic of Indonesia

Your Excellency, the Governor of Bali;
Distinguished Symposium Participants; Ladies and Gentlemen:

First of all, it is my pleasure to welcome you, on behalf of the Government of Indonesia, to Bali. I can tell you that Indonesia is honoured that Bali has been chosen as the venue for this important scientific meeting. I have been told that this symposium has attracted more than 200 scientists from 28 countries, including many from countries outside of the Western Pacific. This reflects that the meeting indeed is important. Perhaps, the Bali environment has contributed to this big turnout. However, there is nothing wrong with that, because it makes for a better meeting when it is possible to combine the useful purpose of the meeting with pleasant surroundings.

Ladies and Gentlemen,

The theme of the symposium, "Sustainability of the Marine Environment: An Integrated Scientific Approach to Coastal Area Management", is intriguing to me. This title explicitly recognizes the multifaceted nature of managing coastal areas; hence the words integrated scientific approach. It also recognizes that in managing coastal areas the overriding concern is that we must assure that we can sustain the marine environment in perpetuity, or vice versa, sound coastal area management can be the answer to being able to sustain the marine environment.

Looking at the theme of the meeting in this way highlights the complex issues that must be addressed by the scientists gathered here today. In addition, if we also envision the actual management or mismanagement practices in our coastal areas, it is quite clear that this is not only an important gathering, but it is also timely.

This symposium addresses questions that are at the core of public policy issues that deal with tradeoffs between protection and preservation of our natural resources on the one hand, and with rational use and development of natural resources on the other hand. Governments, the world over, are constantly faced with these tradeoffs, whether it is in developed or developing countries.

The obvious question that must be addressed is how do we arrive at responsible policy. In my view, the first requirement is that the issues are publically recognized as important. This requirement was clearly met through the June 1992 United Nations Conference on Environment and Development

in Rio de Janeiro, which called for "protection of all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas, and the protection, rational use and development of their living resources". I would like to refer to this statement as a clear statement of intent, expressing the political will, if I may call it this way, to consider environmental issues related to the marine environment seriously. However, I hope you also agree that, by itself, such statement does not set policy, because it does not deal with the level or degree of protection, nor does it prescribe what can be defined as rational use or the type of development that is acceptable vis-a-vis unacceptable.

Ladies and Gentlemen,

From the outset I must confess that I am neither an expert or scientist with experience in coastal area management, nor am I intimately familiar with the detailed impacts, positive or negative, of specific coastal area management methods on the marine environment. Yet, there are certain thoughts that I would like to share with you; ideas which in my view are critical if the scientific community is to contribute to the formulation of policy regarding responsible coastal area management. I hope you allow me to briefly touch upon the following: (1) the need for a greater focus on measurement; (2) the need for improved modelling capability; (3) the need to expand our knowledge on mitigation measures; and (4) the need to include socioeconomic analysis when we develop an integrated scientific approach.

The first observation to be made is that we need to greatly enhance our capability to measure what is going on in the interface between coastal areas and the marine environment. Although seemingly trivial, I think that there is an urgent need to establish and monitor baseline conditions, in terms of physical, chemical or any other parameters, describing the physical phenomena that we as scientists are trying to understand. In this respect we are facing a situation that is continuously changing. A comprehensive set of time series for these parameters is an absolute necessity in order for us to begin to understand the complex physical and biochemical processes responsible for changes in the marine environment, be they good or bad.

As said, expressing the need for measurement is trivial. Yet, it is fundamental because it separates speculation from fact finding. As in most environmental research areas, setting up measurement networks is generally costly and must be related to explicitly addressing the question of what parameters we need or want to measure. Thus, when we want to measure transport phenomena we need to have a clear idea of why certain phenomena are more important than others. If we want to monitor bathymetric conditions we need to be specific in terms of locations, accuracy of measurements and so on. However, the bottom line is that we need to go out and measure, to separate fact from fiction.

As alluded to, we measure in order to understand like a doctor measuring the blood pressure or temperature of a patient to ascertain cause-effect relationships. This is the essence of science. When we talk about a scientific approach, we talk about modelling the real world in order to draw general conclusions about physical phenomena that we observe and measure, and to uncover

cause-effect relationships. Modelling is our way of postulating specific, well defined, cause-effect relationships, whose real existence is proven through measurements in the real world. Thus the need for measurement is closely tied to our need for modelling.

Although science is making great strides in terms of understanding physical phenomena, I would like to point towards the obvious need to concentrate our modelling on unravelling cause-effect relationships, where the hardest question is always the simple one: why are conditions changing, and what are the impacts of changes in conditions? I must be frank with you to state that certain lines of inquiry are not always clear to me. In my view, scientists at times also suffer from the general problem of conducting "science for science sake", without a clear focus on attempting to understand the problems that prompted their inquiry in the first place. If protection of our marine environment is our objective, we must stay focused in our modelling efforts on understanding the chain of cause and effect relationships that threaten this environment.

Ladies and Gentlemen,

From my remarks so far, you may conclude that I place great value on our ability to measure and understand the basic physical phenomena that take place in the interface between activities in coastal areas and the marine environment. However, we can't stop here. As scientists we must also be planners if I may use this term. We must be able to address the formulation of structural and non-structural mitigation measures. Thus, based on knowledge we must look for solutions in terms of how to manage coastal areas in order to achieve sustainability of the marine environment. More importantly, we must be able to determine, based on our modelling capability, what can be expected, predicted if you will, as a result of the implementation of specific mitigation measures.

It is in the area of mitigation or planning measures that there is a need for greatly expanding our horizons on what solutions are to be considered. Solutions can be structural measures, such as the construction of sediment traps. However, they also can be nonstructural. In this regard, it is my belief that non-structural mitigation measures deserve more emphasis than usually accorded. Using flood control as an example, it has become increasingly clear that policies on landuse of the flood plain, or flood proofing of structures in the floodplain, are frequently more effective mitigation measures compared to building physical flood control measures, such as dams.

I think in the area of coastal area management there is an equally wide scope for considering non-structural measures, such as, for example, in implementing and enforcing pollution prevention strategies at the source.

Mitigation or planning measures are sometimes relegated to those outside the scientific arena, with a responsibility for implementation. Although I can understand the reason, I also see a great danger in this. We should involve the scientific community in coming up with measures for coastal area management. Scientists in this regard are not just specialists, called upon to answer special questions. To the contrary, scientists because of their intimate knowledge of the consequences of

certain measures are in the best position to also have a planning responsibility. They should be an integral part of the planning and decision making bodies that are dealing with coastal area management.

Ladies and Gentlemen,

This symposium calls for an integrated scientific approach to coastal area management. Although I think that I know what this means, I also would like to challenge you that no scientific approach is truly complete unless also the socio-economic issues associated with coastal area management are fully integrated into the approach. In particular, tangible and intangible costs and benefits of mitigation measures must be focal points in coming up with responsible policies. When I use the terms costs and benefits these words don't single out costs and benefits measurable in monetary terms, but they also include social costs and benefits, not easily measured in monetary terms.

One only needs to take a look at those who inhabit our coastal areas, or those who make their livelihood from coastal and marine resources to know the value of addressing socio-economic issues related to coastal area management. It is unrealistic to expect that we can come up with responsible policies if we only focus on physical or biological phenomena related to the marine environment. Even the concept of sustainability of the marine environment takes into account the consumptive aspects of using our marine environment.

The point I am making here is neutral, that is, I am neither an advocate for preservation perse, nor am I an advocate for development and irresponsible resource use. Rather, I would like to see that we address all impacts associated with coastal area management, including the socio-economic issues. Only by doing so, will there be hope that we have developed an integrated scientific approach towards coastal area management.

With respect to socio-economic issues, I would like to emphasize that we focus more specifically on enhancing our understanding of what economists call, externalities, i.e. those aspects of human behaviour that are not yet fully captured in the market place. Specifically, in the area of sustaining our marine environment, there are plenty of human activities that fall in this category. Such activities can lead to specific problems in coastal areas, such as the use of special fishing methods. In many cases the basis for sound policy making is to understand the many externalities that need be internalized in our policies.

Ladies and Gentlemen,

My remarks this morning are intended to stimulate discussion and thought, and I hope you will receive them as such. Overriding in mv remarks is my desire that the results of your deliberations will find their way in our improved capability to set responsible policy for our coastal areas. Especially in Indonesia, coastal areas are a defining characteristic of our nation of islands. We are looking

forward to results we can use in confronting the issues that my Government must tackle.

In closing, allow me to express my highest appreciation to IOC/WESTPAC-UNESCO for trusting Indonesia to host the symposium, to LIPI for preparing the meeting, to the Provincial Government of Bali for all the support, and to all participants for coming to this symposium. I am sure that with the excellent preparation this event will be most successful.

Before officially opening this scientific gathering, I would also like to encourage you to enjoy our beautiful Bali, its environment and beaches, coral reefs, and mountains. I hope you will take time out to get to know the people and their unique culture. In doing so, I hope you will remember that the best meetings are those that combine business with pleasure.

Without any further ado, it is now my privilege to declare this symposium officially opened.

Thank you very much.

ANNEX IV

INTERSESSIONAL REPORT OF IOC/WESTPAC PROGRAMME ON OCEAN SCIENCE IN RELATION TO LIVING RESOURCES (OSLR)

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Programme Co-ordinator

Ocean Science in Retation to Living Resources (OSLR) is a joint initiative of the Intergovernmental Oceanographic Commission (IOC) and United Nations Food and Agriculture Organization (FAO). OSLR has both regional and global initiatives. In WESTPAC, Dr. David Tranter was the original Programme Coordinator; for the past 6 years Dr. Peter Rothlisberg CSIRO Australia has been the Coordinator. From the initiation of WESTPAC, OSLR has had two Projects: the Penaeid Recruitment Project (PREP) and Red Tides, more recently called Harmful Algal Blooms (HAB). Dr. Derek Staples, Bureau of Rural Sciences, Australia has been the Project Leader of PREP. Dr. Tomatoshi Okaichi, Japan was the original Project Leader of HAB; he was recently succeeded by Dr. Yasuwo Fukuyo, University of Tokyo, Japan. The following reports have been prepared in conjunction with the Project Technical Leaders.

I. Penaeid Recruitment Project (PREP)

INTRODUCTION

This report is an overview of the progress made in the IOC/WEATPAC Penaeid Recruitment Project (PREP), particularly in the years 1993 and 1994. The report is in five sections:

Background and objectives
Recent PREP activities
Project achievements
Project constrains
Future of PREP

BACKGROUND

The underlying objective of all fisheries management should be to achieve the conservation and sustainable development of the fish stock on which economic and social gains are dependent. To achieve this fundamental objective, managers and policy makers require knowledge of the level to which a stock can be reduced by harvesting but still ensure sustainable recruitment of new fish into future stocks. This knowledge is usually gained by monitoring of the stock abundance (or biomass) trends over time so that appropriate control on the harvest level be applied to achieved sustainability by regulation either inputs (e.g. boat number, size limitations etc.) or outputs of the fishery (e.g. total allowable catch). However, especially in short-lived animals such as penaeid prawns, interpretation of long-term stock trends is complicated by short-term variability in stock abundance resulting from changes in environmental conditions including climate, critical fisheries habitats and pollution. The aim of PREP was to provide a means of distinguishing the effects of these environmental events from those caused by harvesting of the stock.

The specific objectives of PREP were to:

(i) identify the biological and environmental factors which affect recruitment of prawns by comparing prawn stock dynamics across the Indo-west Pacific;

(ii) separate the effects of fishing from natural variability, and;

(iii) provide input into prawn fishery management.

The approach taken by PREP was to monitor both the level of the spawning stock and the level of recruitment (replacement of young prawns in the stock) over a period of years in a range of sites across the Indo-west Pacific. The rationale was that because both level of fishing and the impact of different environmental conditions differed across the region, their effects could be separated. To provide a better comparative approach, research focused on the banana prawn, Penaeus merguiensis, which forms a large porting of the commercial catch of prawns in all participating countries. These countries were: Australia, Brunei Darusalem, Indonesia, Malaysia, Papua New Guinea, the Philippines and Thailand. Research was divided into three distinct phases:

(i) dentification of the spawning stock and recruitment indices to be monitored, based on an analyses of the seasonal dynamics of the main life history stages of the prawn in the different study sites;

(ii) long-term monitoring of spawning stocks, recruitment indices and selected environmental parameters;

(iii) identification of causes of recruitment variability and assessments of stocks.

These phases were all directed towards the provision of management advice on the sustainability and better utilization of the prawn stocks.

The operations in each country was funded directly by either national or bi-lateral funds. The Intergovernmental Oceanographic Commission (IOC) and the Food and Agriculture Organization (FAO) provided some funds for training and overall coordination of the project. In its initial stages, National Coordinators were elected by each country and these key scientists were responsible for the day-to-day implementation of the project, management of staff and other resources. A regional Technical Coordinator from Australia was responsible for training and providing general supervision of project. Over the course of the project, several workshops and meetings were held to provide a forum for planning and coordination and specialist training with different of the project. These included:

1988 Meeting of National Coordinators. Cleveland, Australia
1988 IOC-FAO Workshop on the Recruitment of Penaeid Prawns in the Indo-west Pacific Region (PREP)
Cleveland, Australia. IOC Workshop Report No 56
1989 Meeting of National Coordinators. Phuket, Thailand

1989 Second IOC-FAO Workshop on the Recruitment of Penaeid Prawns in the Indo-west Pacific Region (PREP) Phuket, Thailand. IOC Workshop Report No 64
1990 IOC-FAO Workshop on the Identification of Penaeid Prawn Larvae and Postlarvae. Cleveland, Australia. IOC Workshop report No 71
1991 Meeting of National Coordinators. Penang, Malaysia
1993 In-country Training Visit (PNG, Indonesia, Malaysia, Thailand and Philippines)

RECENT PREP ACTIVITIES

To address specific problems of sampling and database management being experienced by each country, 5-week visit throughout the region was carried by an Australian Technical Expert from 28 February to 4 April 1993 (separate report available from the PREP Technical Coordinator). The aims of this visit were to improve the data quality by visiting field sites and advising on sampling techniques, improve data management and, where appropriate, advise on data analyses and report production. To facilitate the analyses and sharing of data, a common data base application, written specifically for PREP has been provided to all participants.

Recommendations arising from the visit include:

* Continue PREP activities in those countries actively providing in-country support;
* Provide essential sampling equipment, including nets, callipers, microscopes and small aluminium dinghies and motors, and;
* Contract a technician full or part time to provide:

  - expertise in data management in preparation for a workshop
  - hold a workshop on computer and analytical skills
  - encourage and assist in report writing

The Technical Expert noted that PREP has suffered from lack of funds but that it has survived because of the dedication and persistence of PREP personnel. He concluded that if extra funds could be made available IOC/FAO would be rewarded by an outstanding research effort which will assist in the management of prawns throughout the region.

ACHIEVEMENTS

Probably the major achievement to date is the setting up of a regional network of scientists and administrators, all having common goals and objectives. This has facilitated communication on a range of issues and has allowed a valuable exchange of ideas and data across a broad range of cultures and backgrounds. PREP has helped generate a dedicated team of scientists (especially young scientists) who will continue to play a major role in the development of fisheries management expertise both in their own countries and also within the region.

Training in a range of topics has also been provided, but this has been limited by available funds. To address a problem encountered in identification the prawns species, modern techniques used in prawn larval taxonomy, including the use of electrophoresis and numeric taxonomy were introduced to number of participants. Application of the techniques has been constrained in several development of computer skills has also been progressed, but requires further attention. Lack of suitable computer facilities in several countries has been a constraint.

With respect to the 3 main phases of research, progress across the different countries is patchy, reflecting in the main, the support given at the national level by the participating country.

Results arising from phases 1 (seasonal life history dynamics) have been collated and presented at several international meetings, including the Asian Fisheries Forum and the World Fisheries Congress. At this stage of analysis, several gaps in the data from different countries exist but sufficient information was available to present a regional hypothesis which explained the variation seen in the timing of the life history of the different stage of Penaeus merguiensis among the different countries. The hypothesis was based on the importance of monsoonal rainfall to the migration of prawns from their coastal mangrove nursery area into the adjacent coastal area for spawning. It is hoped that as more data are relation to some sites on the relationship between rainfall and prawn movements.

Progress phase 2, long-term monitoring of spawning and recruitment indices, is dependent on the level of progress of phase 1. In general, because of the difficulties encountered in sampling and data base management which have not yet been fully resolved, progress in this area is disappointing and not likely to achieve the desired outcomes. However, the exercise does demonstrate some of the practical difficulties involved in generation the type of time series required by fisheries managers and others in making rational decisions affecting the future viability of fish stacks.

With respect to phase 3, this will be subject of a future workshop and it is hoped that considerable progress can be made when different data sets and experience can be collated and analyzed.

CONSTRAINTS

The major constraints to both the rate of progress and future success of the project is a general lack of communication and feedback, in terms of both overall coordination and standardization of techniques as well as sharing of data and analyses. The only way to resolve this is by appointing a full-time Technical Coordinator (presently based on a voluntary part-time basis) and the provision of regular meetings and workshops to provide feedback on results an data quality issues. As reported earlier, the provision of several key pieces of equipment and recognition of PREP as a formal project would also greatly facilitate progress.

To achieve success, a relatively modest level of funding is required. A proposal to UNDP and other agencies of the necessary funds had not been successful to date, despite the support given to the project by participating countries. Unless this supports is forthcoming in the very near future, the project should be terminated and the resources currently used be re-directed.

FUTURE ACTIVITIES

Future activities are largely dependent on the level of future funding. A workshop to collate and analyze existing data was held from 1-7 November, 1994 and the results reported to both FAO and IOC. The workshop will concentrate on use of database and statistical techniques required for analyses and interpretation of results. No further activities are planned at this stage.

ACKNOWLEDGMENTS

This project would not have been possible without the dedication and support of the PREP National Coordinators and their supporting scientists. The financial support of IOC and FAO is also gratefully acknowledged. The objectives of PREP were always ambitious and although we may not have fully reached our goals, our achievements have been significant. At the very least we have raised the awareness of the difficulties and problems in achieving sustainable development of coastal penaeid fisheries throughout the region. I, like the other PREP participants, remain convinced that the solutions to the very real problems preventing sustainable development of coastal fisheries lie in the integrated use of both harvest fisheries and aquaculture in the coastal zone and that management of both must be based on sound scientific advice and support.

II. Harmful Algal Blooms in WESTPAC Region

BACKGROUND

River inputs of nutrients from land is a major cause of eutrophication in enclosed and semi-enclosed coastal areas where water circulation is incomplete. The eutrophication enhances the occurrence of harmful algal blooms which kill marine organisms. Water-mass circulated from off-shore to near-shore areas often produces toxic plankton which causes toxification of shellfish cultured in coastal areas. The water movements such as convergence, and divergence are related to the occurrence of eutrophication and recurrence of harmful algae. A better understanding of the mechanisms of eutrophication, algal bloom formation, and coastal water circulation will be useful for the development of management plans for the save utilization of the coastal zone.

RECENT ACTIVITIES

At the Second Session of the IPHAB Programme, recommendations were made to minimize duplication of efforts on HAB studies by several programmes such as WESTPAC, CIDA-ASEAN and APEC. Collaboration with these programmes was encouraged and a favorable response was received from Dr. Tsuneo Honjo, from the Fisheries Agency in Japan and Chairman of the planning committee on HAB in APEC.

Another project has also been implemented by CIDA with ASEAN countries. A WESTPAC-HAB representative was invited to the planning meetings of the ASEAN-CIDA project which were held in Jakarta in 1992, Kota Kinabaru in 1993 and Singapore in 1994. On-going WESTPAC-HAB activity has been discussed at these meetings to avoid any duplication of activities. A representative of CIDA has been invited to the WESTPAC symposium in November, 1994.

Seminars

Two seminars were organized by the national leader on HAB. Most expenses including travel of participants, were funded by local committees i.e. Indonesia and Japan.

1993 November (1 day) LIPI, Jakarta, Indonesia
1994 May (1 day followed by 2 day training course)
College of Fisheries, UP in the Visayas, Miagao, Philippines

Publications

"Biology, Epidemiology and Management of Pyrodinium Red Tides" (edited by G.M. Hallegraeff and J.L. Maclean), a proceedings of the management and training workshop held in Brunei Darussalam in 1989 have been reprinted. The proceedings were originally published by ICLARM in Manila in 1989 and are now sold out. ICLARM was not planning to reproduce the book within the next few years so WESTPAC published it with the permission of ICLARM and using financial support from Japan. To keep costs to a minimum no amendments were made and neither logos of IOC or WESTPAC appear in the book. The book sells for US$5.

FUTURE ACTIVITIES

Seminars

A joint seminar of three WESTPAC projects: Harmful Algal Booms, River Inputs, Shelf Circulation is planned for 20-21 November 1994 in Bali, Indonesia, just prior to the 3rd WESTPAC Symposium. The seminar will evaluate the project's on-going activities and establish the future direction of WESTPAC HAB projects, with emphasis on possible collaboration with the River Input and Shelf Circulation project groups.

In 1994 and 1995 seminars will be held at one or two sites in the WESTPAC area. Location and dates have not been confirmed. Close cooperation between local organizers and experts is fundamental for a successful seminar. Local scientists who had the training from the IPHAB and CIDA-ASEAN Programs should be encouraged to join as presenters. Participants will be invited from various institutions, agencies and universities. Topics for the seminar will be arranged depending on the purpose of the seminar, level of knowledge of participants, and facilities available. Seminars will be arranged in conjunction with another meetings of national scientific societies to encourage more participants. In addition to local experts, some experts will be invited from abroad as speakers or lecturers if funds are available. At present there is no financial support available from the IOC-WESTPAC budget and participants are encouraged to raise funds for this purpose.

Publications

ICES have published two reference leaflets on harmful plankton species. A WESTPAC series will be made by building on the ICES document and adding some important species for the WESTPAC region. A positive verbal reply concerning the copy of the contents of the leaflets has been received from Dr. Christopher Hopkins, General Secretary of ICES. Discussions will be held with Dr. Rhodora Corrales of UP-MSI concerning costs and distribution. Funds for this activity are not

available at this stage. It is also planned to make a series of photo slides of harmful plankton associated with shellfish culture methods and red tides. These will be used as reference and training material.

Species Identification Service

A species identification service is to be set up to assist scientists in the region with HAB species identification. A species identification sheet has been prepared and this should be completed and forwarded to Dr. Yasuwo Fukuyo along with a specimen. If he is unable to identify the specimen it will then be forwarded to someone who can and a response forwarded to the sender within a few months. This activity will initially commence in the WESTPAC area followed by assistance being sought from the task team on taxonomy of the IPHAB programme of IOC.

ANNEX I

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33	Workshop on the IREP Component of the IOC Programme on Ocean Science in Relation to Living Resources (OSLR); Halifax, 26-30 September 1963.	E
34	IOC Workshop on Regional Co-operation in Marine Science in the Central Eastern Atlantic (Western Africa); Tenerife, 12-17 December 1963.	E, F, S
35	CCOP/SOPAC-IOC-UNU Workshop on Basic Geo-scientific Marine Research Required for Assessment of Minerals and Hydrocarbons in the South Pacific; Suva, Fiji, 3-7 October 1983.	E
36	IOC/FAO Workshop on the Improved Uses of Research Vessels; Lisbon, 28 May-2 June 1984.	E
36 Suppl.	Papers submitted to the IOC/FAO Workshop on the Improved Uses of Research Vessels; Lisbon, 28 May-2 June 1984.	E
37	IOC/UNESCO Workshop on Regional Co-operation in Marine Science in the Central Indian Ocean and Adjacent Seas and Gulfs; Colombo, 8-13 July 1985.	E
38	IOC/ROPME/UNEP Symposium on Fate and Fluxes of Oil Pollutants in the Kuwait Action Plan Region; Basrah, Iraq, 8-12 January 1984.	E
39	CCOP (SOPAC)-IOC-IFREMER-ORSTOM Workshop on the Uses of Submersibles and Remotely Operated Vehicles in the South Pacific; Suva, Fiji, 24-29 September 1985.	E
40	IOC Workshop on the Technical Aspects of Tsunami Analysis, Prediction and Communications; Sidney, B.C., Canada, 29-31 July 1985.	E
40 Suppl.	First International Tsunami Workshop on Tsunami Analysis, Prediction and Communications, *Submitted Papers;* Sidney, B.C., Canada, 29 July - 1 August 1985.	E
41	First Workshop of Participants in the Joint FAO/IOC/WHO/IAEA/UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region (WACAF/2); Dakar, Senegal, 28 October-1 November 1985.	E
43	IOC Workshop on the Results of MEDALPEX and Future Oceanographic Programmes in the Western Mediterranean; Venice, Italy, 23-25 October 1985.	E
44	IOC-FAO Workshop on Recruitment in Tropical Coastal Demersal Communities; Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986.	E (out of stock) S
44 Suppl.	IOC-FAO Workshop on Recruitment in Tropical Coastal Demersal Communities, *Submitted Papers;* Ciudad del Carmen, Campeche, Mexico, 21-25 April 1986.	E
45	IOCARIBE Workshop on Physical Oceanography and Climate; Cartagena, Colombia, 19-22 August 1986.	E
46	Reunión de Trabajo para Desarrollo del Programa "Ciencia Oceánica en Relación a los Recursos No Vivos en la Región del Atlántico Sud-occidental"; Porto Alegre, Brazil, 7-11 de abril de 1986.	S
47	IOC Symposium on Marine Science in the Western Pacific: The Indo-Pacific Convergence; Townsville, 1-6 December 1966.	E
48	IOCARIBE Mini-Symposium for the Regional Development of the IOC-UN (OETB) Programme on 'Ocean Science in Relation to Non-Living Resources (OSNLR)'; Havana, Cuba, 4-7 December 1986.	E, S
49	AGU-IOC-WMO-CPPS Chapman Conference: An International Symposium on 'El Niño'; Guayaquil, Ecuador, 27-31 October 1986.	E
50	CCALR-IOC Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, particularly Krill (organized in collaboration with SCAR and SCOR); Paris, France, 2-6 June 1987.	E
51	CCOP/SOPAC-IOC Workshop on Coastal Processes in the South Pacific Island Nations; Lae, Papua-New Guinea, 1-8 October 1987.	E

No.	Title	Languages
52	SCOR-IOC-UNESCO Symposium on Vertical Motion in the Equatorial Upper Ocean and its Effects upon Living Resources and the Atmosphere; Paris, 6-10 May 1985.	E
53	IOC Workshop on the Biological Effects of Pollutants; Oslo, 11-29 August 1986.	E
54	Workshop on Sea-Level Measurements in Hostile Conditions; Bidston, UK, 28-31 March 1988	E
55	IBCCA Workshop on Data Sources and Compilation, Boulder, Colorado, 18-19 July 1988.	E
56	IOC-FAO Workshop on Recruitment of Penaeid Prawns in the Indo-West Pacific Region (PREP); Cleveland, Australia, 24-30 July 1988.	E
57	IOC Workshop on International Co-operation in the Study of Red Tides and Ocean Blooms; Takamatsu, Japan, 16-17 November 1987.	E
58	International Workshop on the Technical Aspects of the Tsunami Warning System; Novosibirsk, USSR, 4-5 August 1989.	E
58 Suppl.	Second International Workshop on the Technical Aspects of Tsunami Warning Systems, Tsunami Analysis, Preparedness, Observation and Instrumentation. *Submitted Papers*; Novosibirsk, USSR, 4-5 August 1989.	E
59	IOC-UNEP Regional Workshop to Review Priorities for Marine Pollution Monitoring Research, Control and Abatement in the Wider Caribbean; San José, Costa Rica, 24-30 August 1989.	E, F, S
60	IOC Workshop to Define IOCARIBE-TRODERP proposals; Caracas, Venezuela, 12-16 September 1989.	E
61	Second IOC Workshop on the Biological Effects of Pollutants; Bermuda, 10 September-2 October 1988.	E
62	Second Workshop of Participants in the Joint FAO-IOC-WHO-IAEA-UNEP Project on Monitoring of Pollution in the Marine Environment of the West and Central African Region; Accra, Ghana, 13-17 June 1988.	E
63	IOC/WESTPAC Workshop on Co-operative Study of the Continental Shelf Circulation in the Western Pacific; Bangkok, Thailand, 31 October-3 November 1989.	E
64	Second IOC-FAO Workshop on Recruitment of Penaeid Prawns in the Indo-West Pacific Region (PREP); Phuket, Thailand, 25-31 September 1989.	E
65	Second IOC Workshop on Sardine/Anchovy Recruitment Project (SARP) int he Southwest Atlantic; Montevideo, Uruguay, 21-23 August 1989.	E
66	IOC *ad hoc* Expert Consultation on Sardine/Anchovy Recruitment Programme; La Jolla, California, USA, 1989.	E
67	Interdisciplinary Seminar on Research Problems in the IOCARIBE Region; Caracas, Venezuela, 28 November-1 December 1989.	E (out of stock)
68	International Workshop on Marine Acoustics; Beijing, China, 26-30 March 1990.	E
69	IOC-SCAR Workshop on Sea-Level Measurements in the Antarctica; Leningrad, USSR, 28-31 May 1990.	E
69 Suppl.	IOC-SCAR Workshop on Sea-Level Measurements in the Antarctica; *Submitted Papers*; Leningrad, USSR, 28-31 May 1990.	E
70	IOC-SAREC-UNEP-FAO-IAEA-WHO Workshop on Regional Aspects of Marine Pollution; Mauritius, 29 October - 9 November 1990.	E
71	IOC-FAO Workshop on the Identification of Penaeid Prawn Larvae and Postlarvae; Cleveland, Australia, 23-28 September 1990.	E
72	IOC/WESTPAC Scientific Steering Group Meeting on Co-Operative Study of the Continental Shelf Circulation in the Western Pacific; Kuala Lumpur; Malaysia, 9-11 October 1990.	E
73	Expert Consultation for the IOC Programme on Coastal Ocean Advanced Science and Technology Study; Liège, Belgium, 11-13 May 1991.	E
74	IOC-UNEP Review Meeting on Oceanographic Processes of Transport and Distribution of Pollutants in the Sea; Zagreb, Yugoslavia, 15-18 May 1989.	E
75	IOC-SCOR Workshop on Global Ocean Ecosystem Dynamics; Solomons, Maryland, USA, 29 April-2 May 1991.	E
76	IOC/WESTPAC Scientific Symposium on Marine Science and Management of Marine Areas of the Western Pacific; Penang, Malaysia, 2-6 December 1991.	E
77	IOC-SAREC-KMFRI Regional Workshop on Causes and Consequences of Sea-Level Changes on the Western Indian Ocean Coasts and Islands; Mombasa, Kenya, 24-28 June 1991.	E
78	IOC-CEC-ICES-WMO-ICSU Ocean Climate Data Workshop Goddard Space Flight Center; Greenbelt, Maryland, USA, 18-21 February 1992.	E
79	IOC/WESTPAC Workshop on River Inputs of Nutrients to the Marine Environment in the WESTPAC Region; Penang, Malaysia, 26-29 November 1991.	E
80	IOC-SCOR Workshop on Programme Development for Harmful Algae Blooms; Newport, USA, 2-3 November 1991.	E
81	Joint IAPSO-IOC Workshop on Sea Level Measurements and Quality Control; Paris, 12-13 October 1992.	E
82	BORDOMER 92: International Convention on Rational Use of Coastal Zones. A Preparatory Meeting for the Organization of an International Conference on Coastal Change; Bordeaux, France, 30 September-2 October 1992.	E
83	IOC Workshop on Donor Collaboration in the Development of Marine Scientific Research Capabilities in the Western Indian Ocean Region; Brussels, Belgium, 12-13 October 1992.	E
84	Workshop on Atlantic Ocean Climate Variability; Moscow, Russian Federation, 13-17 July 1992.	E
85	IOC Workshop on Coastal Oceanography in Relation to Integrated Coastal Zone Management; Kona, Hawaii, 1-5 June 1992.	E
86	International Workshop on the Black Sea; Varna, Bulgaria 30 September - 4 October 1991.	E
87	Taller de trabajo sobre efectos biológicos del fenómeno «El Niño» en ecosistemas costeros del Pacífico Sudeste; Santa Cruz, Galápagos, Ecuador, 5-14 de octubre de 1989.	S only (Summary in E, F, S)
88	IOC-CEC-ICSU-ICES Regional Workshop for Member States of Eastern and Northern Europe (GODAR Project); Obninsk, Russia, 17-20 May 1993.	E
89	IOC-ICSEM Workshop on Ocean Sciences in Non-Living Resources; Perpignan, France, 15-20 October 1990.	E
90	IOC Seminar on Integrated Coastal Management; New Orleans, USA. 17-18 July 1993.	E
91	Hydroblack'91 CTD Intercalibration Workshop; Woods Hole, USA. 1-10 December 1991.	E
92	Réunion de travail IOCEA-OSNLR sur le Projet « Budgets sédimentaires le long de la côte occidentale d'Afrique » Abidjan, Côte d'Ivoire, 26-28 juin 1991.	F
93	IOC-UNEP Workshop on Impacts of Sea-Level Rise due to Global Warming. Dhaka, Bangladesh, 16-19 November 1992.	E
94	BMTC-IOC-POLARMAR International Workshop on Training Requirements in the Field of Eutrophication in Semi-Enclosed Seas and Harmful Algal Blooms, Bremerhaven, Germany, 29 September - 3 October 1992.	E
95	SAREC-IOC Workshop on Donor Collaboration in the Development of Marine Scientific Research Capabilities in the Western Indian Ocean Region; Brussels, Belgium, 23-25 November 1993.	E
96	IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts; Zanzibar, United Republic of Tanzania, 17-21 January 1994.	E
96 Suppl. 1	IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts; *Submitted Papers* 1. Coastal Erosion; Zanzibar, United Republic of Tanzania 17-21 January 1994.	E
96 Suppl. 2	IOC-UNEP-WMO-SAREC Planning Workshop on an Integrated Approach to Coastal Erosion, Sea Level Changes and their Impacts; *Submitted Papers* 2. Sea Level; Zanzibar, United Republic of Tanzania 17-21 January 1994.	E
97	IOC Workshop on Small Island Oceanography in Relation to Sustainable Economic Development and Coastal Area Management of Small Island Development States; Fort-de-France, Martinique, 8-10 November, 1993.	E
98	CoMSBlack '92A Physical and Chemical Intercalibration Workshop; Erdemli, Turkey, 15-29 January 1993.	E
99	IOC-SAREC Field Study Exercise on Nutrients in Tropical Marine Waters; Mombasa, Kenya, 5-15 April 1994.	E
100	IOC-SOA-NOAA Regional Workshop for Member States of the Western Pacific - GODAR-II (Global Oceanographic Data Archeology and Rescue Project); Tianjin, China, 8-11 March 1994.	E
101	IOC Regional Science Planning Workshop on Harmful Algal Blooms; Montevideo, Uruguay, 15-17 June 1994.	E
102	First IOC Workshop on Coastal Ocean Advanced Science and Technology Study (COASTS); Liège, Belgium, 5-9 May 1994.	E
103	IOC Workshop on GIS Applications in the Coastal Zone Management of Small Island Developing States; Barbados, 20-22 April 1994.	E
104	Workshop on Integrated Coastal Management; Dartmouth, Canada, 19-20 September 1994.	E
105	BORDOMER 95: Conference on Coastal Change; Bordeaux, France, 6-10 February 1995.	E
106	IOC/WESTPAC Workshop on the Paleographic Map; Bali, Indonesia, 20-21 October 1994.	E
107	IOC-ICSU-NIO-NOAA Regional Workshop for Member States of the Indian Ocean - GODAR-III; Dona Paula, Goa, India, 6-9 December 1994.	E
108	UNESCO-IHP-IOC-IAEA Workshop on Sea-Level Rise and the Multidisciplinary Studies of Environmental Processes in the Caspian Sea Region; Paris, 9-12 May 1995.	E
108 Suppl.	UNESCO-IHP-IOC-IAEA Workshop on Sea-Level Rise and the Multidisciplinary Studies of Environmental Processes in the Caspian Sea Region; *Submitted Papers*; Paris, 9-12 May 1995.	E
109	First IOC-UNEP CEPPOL Symposium; San José, Costa Rica, 14-15 April 1993.	E
110	IOC-ICSU-CEC Regional Workshop for Member States of the Mediterranean - GODAR-IV (Global Oceanographic Data Archeology and Rescue Project) Foundation for International Studies, University of Malta, Valletta, Malta, 25-28 April 1995.	E
111	Chapman Conference on the Circulation of the Intra-Americas Sea; La Parguera, Puerto Rico, 22-26 January 1995.	E

No.	Title	Languages
112	IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials (GESREM) Workshop; Miami, USA, 7-8 December 1993.	E
113	IOC Regional Workshop on Marine Debris and Waste Management in the Gulf of Guinea; Lagos, Nigeria, 14-16 December 1994.	E
114	International Workshop on Integrated Coastal Zone Management (ICZM) Karachi, Pakistan; 10-14 October 1994.	E
115	IOC/GLOSS-IAPSO Workshop on Sea Level Variability and Southern Ocean Dynamics; Bordeaux, France, 31 January 1995.	E
116	IOC/WESTPAC International Scientific Symposium on Sustainability of Marine Environment: Review of the WESTPAC Programme, with Particular Reference to ICAM Bali, Indonesia, 22-26 November 1996	E