Intergovernmental Oceanographic Commission

Workshop Report No. 76

IOC/WESTPAC Scientific Symposium on Marine Science and Management of Marine Areas of the Western Pacific

Penang, Malaysia, 2-6 December 1991

UNESCO

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No.	Title	Languages
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2	CICAR Ichthyoplankton Workshop. Mexico City, 16-27 July 1974 (UNESCO Technical Paper in Marine Sciences. No. 20).	E (out of stock) S (out of stock)
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5	IDOE International Workshop on Marine Geology and Geophysics of the Caribbean Region and its Resources. Kingston, Jamaica, 17-22 February 1975.	E (out of stock) S
6	Report of the CCOP/SOPAC-IOC IDOE International Workshop on Geology, Mineral Resources and Geophysics of the South Pacific. Suva, Fiji, 1-6 September 1975.	E
7	Report of the Scientific Workshop to Initiate Planning for a Co-operative Investigation in the North and Central Western Indian Ocean, organized within the IDOE under the sponsorship of IOC/FAO(IOFC)/UNESCO/EAC. Nairobi, Kenya, 25 March-2 April 1976.	E, F, S, R
8	Joint IOC/FAO (IPFC)/UNEP International Workshop on Marine Pollution in East Asian Waters, Penang, 7-13 April 1976.	E (out of stock)
9	IOC/CMG/SCOR Second International Workshop on Marine Geoscience Mauritius, 9-13 August 1976.	E, F, S, R
10	IOC/WMO Second Workshop on Marine Pollution (Petroleum) Monitoring, Monaco, 14-18 June 1976	E, F, S (out of stock) R
11	Report of the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions. Port of Spain, Trinidad, 13-17 December 1976.	E, S (out of stock)
11 Suppl.	Collected contributions of invited lecturers and authors to the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions. Port of Spain, Trinidad, 13-17 December 1976.	E (out of stock), S
12	Report of the IOCARIBE Interdisciplinary Workshop on Scientific Programmes in Support of Fisheries Projects. Fort-de-France, Martinique, 28 November-2 December 1977.	E, F, S
13	Report of the IOCARIBE Workshop on Environmental Geology of the Caribbean Coastal Area, Port of Spain, Trinidad, 16-18 January 1978	E, S
14	IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas. Abidjan, Ivory Coast, 2-9 May 1978	E, F
15	CPPS/FAO/IOC/UNEP International Workshop on Marine Pollution in the South-East Pacific. Santiago de Chile, 6-10 November 1978.	E (out of stock)
16	Workshop on the Western Pacific Tokyo, 19-20 February 1979.	E, F, R
17	Joint IOC/WMO Workshop on Oceanographic Products and the IGOSS Data Processing and Services System (IDPSS), Moscow, 9-11 April 1979.	E
17 Suppl.	Papers submitted to the Joint IOC/WMO Seminar on Oceanographic Products and the IGOSS Data Processing and Services System. Moscow, 2-6 April 1979	E
18	IOC/UNESCO Workshop on Syllabus for Training Marine Technicians. Miami, 22-26 May 1978 (UNESCO reports in marine sciences. No. 4 published by the Division of Marine Sciences, UNESCO)	E (out of stock), F S (out of stock), R
19	IOC Workshop on Marine Science Syllabus for Secondary Schools. Llantwit Major, Wales, U.K. 5-9 June 1978 (UNESCO reports in marine sciences. No. 5 published by the Division of Marine Sciences, UNESCO)	E (out of stock), F, S, R, Ar
20	Second CCOP-IOC Workshop on IDOE Studies of East Asia Tectonics and Resources Bandung, Indonesia, 17-21 October 1978	E
21	Second IDOE Symposium on Turbulence in the Ocean, Liege, Belgium, 7-18 May 1979.	E, F, S, R
22	Third IOC/WMO Workshop on Marine Pollution Monitoring, New Delhi, 11-15 February 1980.	E, F, S, R
23	WESTPAC Workshop on the Marine Geology and Geophysics of the North-West Pacific, Tokyo, 27-31 March 1980.	E, R
24	WESTPAC Workshop on Coastal Transport of Pollutants, Tokyo, 27-31 March 1980.	E (out of stock)
25	Workshop on the Intercalibration of Sampling Procedures of the IOC/WMO UNEP Pilot Project on Monitoring Background Levels of Selected Pollutants in Open-Ocean Waters, Bermuda, 11-26 January 1980.	E (superseded by IOC Technical Series No. 22)
26	IOC Workshop on Coastal Area Management in the Caribbean Region, Mexico City, 24 September-5 October 1979.	E, S
27	CCOP/SOPAC-IOC Second International Workshop on Geology, Mineral Resources and Geophysics of the South Pacific, Noumea, New Caledonia, 9-15 October 1980.	E
28	FAO/IOC Workshop on the effects of environmental variation on the survival of larval pelagic fishes, Lima, 20 April-5 May 1980	E
29	WESTPAC Workshop on Marine biological methodology, Tokyo, 9-14 February 1981.	E
30	International Workshop on Marine Pollution in the South-West Atlantic Montevideo, 10-14 November 1980.	E (out of stock) S
31	Third International Workshop on Marine Geoscience, Heidelberg, 19-24 July 1982	E, F, S
32	UNU/IOC/UNESCO Workshop on International Co-operation in the Development of Marine Science and the Transfer of Technology in the context of the New Ocean Regime Paris, 27 September - 1 October 1982	E, F, S
32 Suppl.	Papers submitted to the UNU/IOC/UNESCO Workshop on International Co-operation in the Development of Marine Science and the Transfer of Technology in the Context of the New Ocean Regime Paris, 27 September-1 October 1982	E
33	Workshop on the IREP Component of the IOC Programme on Ocean Science in Relation to Living Resources (OSLR) Halifax, 26-30 September 1983	E
34	IOC Workshop on Regional Co-operation in Marine Science in the Central Eastern Atlantic (Western Africa) Tenerife 12-17 December 1983	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 Inproved 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 Analyses, Prediction and Communications, Sidney, B.C., Canada, 29-31 July 1985	E
40 Suppl.	IOC Workshop on the Technical Aspects of Tsunami Analyses, Prediction and Communications. *Submitted Papers* Sidney, B.C., Canada, 29-31 July 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 Oceanica en Relacion a los Recursos No vivos en la Región del Atlantico Sudoccidental, 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 1986	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" Guyaquil, Ecuador, 27-31 October 1986	E
50	CCAMLR-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
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

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1. INTRODUCTION

The IOC Sub-Commission for the Western Pacific recommended, at its First Session, (Hangzhou, China, 5-9 February 1990), by Recommendation SC-WESTPAC-I.1, that a major international IOC-WESTPAC Marine Science Symposium be organized in 1991 or 1992.

An International Steering Committee for the preparation of the Symposium was established during the First Session of the Sub-Commission, chaired by Dr. J. Baker. The Committee discussed the objectives, structure and other detailed issues of the Symposium and strongly recommended that the venue of the Symposium be adjacent to the WESTPAC region.

The Delegation of Malaysia at the Twenty-third Session of the Executive Council of the IOC offered to host the Symposium in Malaysia. The Council warmly welcomed the offer of Malaysia and invited regional and global international bodies to support the international IOC/WESTPAC Marine Science Symposium.

Financial support provided by Australia, France, Japan, Malaysia, the Netherlands, United Kingdom and United States, contributed to the success of the Symposium. The Programme of the Symposium is attached as Annex I. Approximately 150 participants from 25 countries in and outside the WESTPAC region attended the Symposium. About 90 papers were presented either at plenary sessions or at workshops organized in conjunction with the Symposium. The List of participants is shown in Annex II.

2. OPENING

The Symposium opened at 0900 hours on 2 December 1991 in the Bayview Pacific Hotel, Penang, Malaysia.

Dato' Mohd Noordin Hassan, Secretary-General of the Ministry of Science, Technology and the Environment of Malaysia delivered the opening address. He emphasized the important role of the oceans, especially in the coastal zone areas, as a food-supply source or as major area for study of climate changes. He stressed the special attention paid by the Government of Malaysia to the marine sciences and their management, and the willingness of his authorities to co-operate with scientists from other countries, as well as with international organizations.

The Secretary-General, speaking on behalf of the Organizing Committee of the Symposium, thanked the Governments of Australia, France, Japan, the Netherlands, the United Kingdom and the United States for the support they kindly provided to the Symposium. He welcomed all participants to the beautiful island of Malaysia, and wished them a successful meeting and an enjoyable stay.

Dr. Gunnar Kullenberg, Secretary IOC, speaking on his own behalf and on that of the Commission, expressed sincere gratitude to the Government of Malaysia for hosting the Symposium. He thanked all of the donor countries for contributing to the success of the Symposium by the support they had provided. He also thanked Dr. J. Baker and all members of International Steering Committee for their excellent preparation and organization of the Symposium. The Secretary welcomed all participants to this important scientific meeting.

The Secretary IOC briefly reviewed progress in the WESTPAC region. He introduced new programmes developed by IOC in co-operation with other UN agencies and referred in particular to the Global Ocean Observing System (GOOS). He welcomed scientists and institutions supporting and actively participating in such programmes.

The Symposium was officially opened by the Honorable Peter Chin Fah Kui, Deputy Minister of Science, Technology and the Environment, Malaysia, who welcomed participants to the Symposium and stressed the importance of the development of the marine sciences, the rational uses of marine resources and

the protection of the marine environment.

Professor John Gray, University of Oslo, Norway, presented an overview address to the Symposium. Taking Global Investigation of Pollution in the Marine Environment (GIPME) as an example, he indicated the significant role of international co-operation in marine scientific research and monitoring. He reviewed historical development of marine sciences and introduced some current topics on marine science with special emphasis on marine environment studies and the impact on biological aspects. The overview address was the subject of a lot of interest on the part of participants.

3. SCIENTIFIC PRESENTATION

As defined by the International Steering Committee and adopted by the IOC Executive Council at its Twenty-third Session, the scientific presentations covered four topics and keynote speeches were given respectively on :

(a) Ocean Variability and Links with Climate Change
Professor Tomio Asai, Ocean Research Institute, Tokyo University, Japan

(b) Causes and Impacts of the Sea Level Change
Professor Klaus Wyrtki, University of Hawaii, USA

(c) Biogeochemical Processes
Professor Jean Martin, Institut de Biogeochimie Marine, Ecole Normale Supérieure, France

(d) Managing the Marine Environment
Dr. Abu Bakar Jaafar, Department of Environment, Malaysia

In addition, the Secretary IOC made a presentation on the need for development of a Global Ocean Observing System, the IOC actions in this respect and the associated required cooperation and TEMA needs.

Some 25 papers were presented in the Plenary Sessions under these four topics with references to national and regional projects. Thanks to the efforts made by the Organizing Committee and donor countries, it was obvious that young scientists from the region are actively involved in the national, regional and international programmes of marine sciences and services and some interesting results were presented to the Symposium. The abstracts of the presentations are attached as Annex III of this report.

The Keynote speakers for each topic were invited to follow all presentations and discussions, and to summarize the outcome together with suggestions to all participants in a plenary session on the last day of the Symposium.

All papers presented to the Symposium will be published by the Organizing Committee in the first half of 1992 as the Proceedings of the Symposium.

A special session, on Western Boundary Current and its Decadal Variation,jointly initiated by the CCCO Pacific Panel and the WESTPAC project on Co-operative Studies of Ocean Dynamics in the Northwest Pacific, was organized during the Symposium. This attempt to link global programmes with regional efforts has proved to be a successful experience. A total of 6 papers were presented to the plenary session, discussions and suggestions on which are dealt with under the respective regional topic.

4. DISCUSSION AND RECOMMENDATION FOR WESTPAC PROJECT

Nine parallel workshops were organized for the respective nine

WESTPAC projects adopted by the IOC Sub-Commission for WESTPAC. The workshops reviewed progress during the intersessional period and discussed further implementation of the projects. The different workshops were dealt with sequentially, the 9 topics being:

- Toxic and anoxic phenomena associated with algal blooms;
- Recruitment of penaeid prawns in the Indo-Western Pacific Region;
- Paleogeographic mapping;
- Margins of active plates;
- Climatic records in long lived corals;
- Co-operative studies of ocean dynamics in the Northwest Pacific;
- Monitoring heavy metals and organochloeine pesticides using the mussel watch approach;
- Co-operative research of the continental shelf circulation in the Western Pacific; and
- Assessment of riverine inputs to the sea in the WESTPAC region.

The discussion at the workshops concluded as follows :

4.1 TOXIC AND ANOXIC PHENOMENA ASSOCIATED WITH ALGAL BLOOMS

Recommendations:

(i) **The IOC and the IOC/WESTPAC Secretariat should convene a working group and commit funds for the creation and distribution of a manual on techniques used in field and laboratory studies on harmful algal blooms.**

Comment: This manual is to be a compilation of new material together with existing protocols that are now scattered throughout the literature. The emphasis should be on the species and techniques that are appropriate for the WESTPAC region, recognizing the limitations many countries have with respect to expensive or highly technical equipment. The manual will initially be distributed to individuals for comments and revisions, and then tested and refined further at a training workshop. Translation of this manual into national languages of the WESTPAC countries should be considered as a possible future WESTPAC activity.

(ii) **The IOC and WESTPAC should support the creation and distribution of a regional newsletter on harmful algal blooms.**

Comment: This effort will only succeed if Task Team members actively contribute to the newsletter. Initial efforts to distribute a newsletter twice each year to approximately 100 individuals will be coordinated by D.M. Anderson (USA) and Rhodora Corrales (Philippines) but the eventual goal will be for a publication entirely sustained by workers from the region. On occasion, rapid communication will be needed (e.g. large scale red tide out breaks), so special bulletins can be distributed from the WESTPAC Secretariat via fax to selected individuals in each country.

(iii) **The IOC and WESTPAC should provide funds for training workshops and scientific exchange visits.**

Comment: Once a protocol manual is available, a regional training workshop should be convened at a marine field station within the region where there is easy access to waters where harmful red tide blooms occur. The training activities will be centered around the manual, as this will not only provide valuable feedback on the usefulness of the material but will also enhance the training

process. Participation in the workshop should be strictly controlled to include only those who have had, and will continue to have, direct activities in the collection and analysis of field samples. Participants will be nominated by members of each country's Task Team, with final selection by the Task Team Chairman and Workshop Coordinator.

(iv) **The IOC and WESTPAC should provide funds for the creation and distribution of photographs, slides, and preserved samples of harmful bloom species from the WESTPAC region.**

Comment: Many of the photographic materials already exist, so it is just a matter of duplication and distribution. A fixed number of sets of this material (5-10) will be sent to each country, with the distribution of these sets within each country to be determined by Task Team Members. At present, there are not sufficient supplies of preserved plankton materials for distribution. Through the newsletter, requests will be made for workers to obtain large quantities of bloom organisms and to preserve them with appropriate methods. These samples will be collected in a central location and distributed in vials as reference materials once taxonomic authorities have examined and categorized them.

(v) **As an adjunct to training workshops, the IOC and WESTPAC should provide funds for expert visits to individual countries, and for long-term training fellowships (TEMA) for WESTPAC Country scientists to expert laboratories.**

Comment: Workshops provide important training, but considerable benefit can be obtained from longer, more personal interactions in expert laboratories or by visits of experts to specific WESTPAC country laboratories.

(vi) **Recognizing the need for increased understanding and recognition of the serious threat to coastal marine resources and to public health posed by harmful algal blooms, the IOC and the WESTPAC Secretariat should work closely with Task Team scientists and high level policy-making officials in member countries and regional organizations so that priority is given to obtaining external aid for bloom research and monitoring.**

Comment: Several large international programmes on harmful blooms are under consideration for funding, but the success of these proposals will be a direct function of the specific enthusiasm and support provided by national planning agencies. These agencies are faced with difficult decisions between competing infrastructure development. If the importance of harmful bloom studies can be adequately communicated by Task Team scientists and a high priority established at the national level, external agencies will be responsive to the perceived needs. To achieve this, Task Team members, the IOC, and WESTPAC Secretariat will need to become politicians and "salesmen/women". To start this process some guidelines will be mailed to Task Team members that can be used to build arguments, and eventually to write letters for planning agency use in their contacts with UNDP, and other funding sources. Funds will not be provided by these agencies unless they are convinced that harmful bloom programmes are of great national and regional importance. Since most national research and monitoring programmes in the WESTPAC countries are not well-funded at present, it will not be easy to change the perception of these phenomena at the national level.

(vii) **Convene a regional symposium on the harmful algal blooms, possibly to be held in conjunction with the marine pollution programme in WESTPAC**

Comment: Periodic exchange of scientific information is a necessary component of the WESTPAC harmful algal bloom network. The symposium should focus on harmful blooms, although some presentations from regional pollution studies would be informative.

(viii) **The IOC and the WESTPAC Secretariat should explore ways to supplement ongoing or planned multi-lateral programmes on harmful algal blooms (e.g. ASEAN/Canada) so that non-ASEAN WESTPAC countries can participate in the training activities of those programmes.**

Comment: Several major aid programmes are being implemented that provide training in harmful bloom research issues to certain, but not all, the WESTPAC countries. Examples are the ASEAN/Canada red tide programme, and bi-lateral agreements between Japan and Thailand or the Philippines. Through negotiations with responsible officials in these programmes and using WESTPAC funds, it may be possible to expand participation in the training aspects of these programmes to include more WESTPAC countries.

4.2 RECRUITMENT OF PENAEID PRAWNS IN THE INDO-WESTERN PACIFIC REGION

Recommendations:

(i) IOC and FAO to continue to support PREP activities under the Ocean Science in relation to Living Resources Programme (OSLR). In particular IOC-FAO must arrange a memorandum of understanding or contract between the WESTPAC Sub-Commission and the participating countries.

(ii) Following the successful training workshops already provided through PREP, IOC-FAO should provide support for a technical adviser to conduct in-country training in the areas of

a) sampling methods and standardization;
b) data processing;
c) taxonomy; and
d) publication of results

(iii) In response to the UNDP request for national Governments to express their support for the application of funding (RAS/89/012), PREP National coordinators should request that their respective coordinating agencies consider the importance of the project in relation to national priorities, and communicate their support to UNDP.

(iv) That the IOC-FAO Secretariats coordinate national responses at a regional level and communicate with UNDP/ACIAR.

(v) PREP activities for 1992 should include:

a) Continue monthly/fortnightly sampling of adults/spawning, sub adults emigrants, juveniles as high priority, and sampling of post larvae and larvae as lower priority;

b) Increase the exchange of sampling results and taxonomic material;

c) Continue collection of environmental data;

d) Establish regional database of larval and post larval taxonomy before embarking on continued sampling;

e) Enter and edit sampling data using the PREP database.

(vi) Establish better cooperative links with the related WESTPAC

project "Cooperative studies of continental shelf circulation in the WESTPAC".

4.3 PALEOGEOGRAPHIC MAPPING

The activities recommended for 1992/93 are:

Distribution of information package to potential working group members by February 1992;

Drafting of base-map for the project, including a suggested paleo-coastline at the present 120m isobath, January - May 1992;

Distribution of base-map to working group members, June 1992;

Compilation preliminary data by the working group at a combined Training Course/Workshop in either Hong Kong or Bangkok in August 1992;

Presentation of preliminary data to the Asian Marine Geology Conference, Tokyo, August 1992;

Final compilation of map and submission for publication, together with related papers, May 1993;

Publication of maps and related papers before the end of 1993.

4.4 MARGINS OF ACTIVE PLATES

The group concluded its discussions as follows:

An increasing demand for coastal studies was reflected. A new proposal on neotectonic change on coastal areas represents a part of boundary processes of forearc sliners/microplates.

After discussion, the following two revisions were made: additions of arc volcanism associated with arc rift and neotectonics in coastal areas, both of which are very active components of boundary processes of forearc sliners/microplates, and of transform fault associated with collision.

Coordination/collaboration with other bodies was also discussed. Ocean Mapping of IOC recently established Western Pacific Editorial Board. CCOP (SEATER) - Circum pacific Conference for Energy Mineral Resources (CPC) decided to create geotectonic map project recently. They should be contacted to avoid duplication.

Future Meetings and planned Cruises

The 2nd International Conference on Asian Marine Geology will be held in Tokyo, 19-22 August 1992, and the 29th International Geological congress in Kyoto, 24 August 1992. The Symposium on Ocean Science in Relation to Non-Living Resources (OSLR) will be arranged in conjunction with these events in Japan. Duplications will be avoided by ensuring regular flow of information between those concerned. IOC and WESTPAC Secretariat are invited to approach the Governments concerned with a view to having funds released **inter alia** to support a few invited scientists from the WESTPAC region.

The Hakuho-maru cruise for Izu-Bonin Ridge from May to June 1992 and Tansei-maru cruise for South China Sea in 1993 are considered and planned as WESTPAC cruises in geology and geophysics. At least one participating scientist will joint from WESTPAC region.

4.5 CLIMATE RECORDS IN LONG LIVED CORALS

Overall Objective: Australian Institute of Marine Science (AIMS) stressed the

concept that the objective is to train, and subsequently collaborate with, scientists and technologists from the IOC-WESTPAC region.

The collaboration is seen to be long-term and extensive.

Initial contacts will be in the participating countries. Initial training on respective home-country samples will be in AIMS.

Subsequently equipment would be expected to be developed in each participating country.

Data would be held in home-countries and a central, accessible, data-base would be established at AIMS.

First Phase of Study

(i) to determine the availability and suitability of massive corals in particular locations in the WESTPAC region for banding studies;

(ii) to determine the availability of logistic support for underwater core drilling in massive corals at these locations;

(iii) to identify relevant workers in member countries currently involved or wanting to be involved in porites banding studies;

(iv) to co-ordinate the collection of small coral heads for initial analyses at AIMS; and

(v) to report to IOC/WESTPAC on the above.

Second Phase of Study

Purpose: To provide researchers from IOC/WESTPAC countries with a broad knowledge in the current techniques, methods and understanding of environmental records in massive corals.

Activities: Participants should bring a number of small samples of massive corals to work with during their visit. These will be sliced, X-rayed and various parameters measured e.g. fluorescence, density profile. In carrying out these procedures on their own samples the participants should gain an understanding of the procedures and problems involved.

Participants: The participants should be established researchers (rather than students or technicians) with a strong interest in developing coral chronology programmes in their home countries).

Length of Stay Ideally, 2 to 3 months with no more than two participants at any one time.

Funding Requirements: Return airfare, accommodation and living expenses. (possible use of AIMS on-site accommodation $50 per week unit or $80 per week for a house = $ 600 - 960 for 3 months).

Cost of x-raying samples (about $250 per hour at local hospital), development of positive prints $5-8 each at AIMS = about $100), miscellaneous materials and store (about $4000). Total for materials and stores about $ 750 per participant.

These figures are Australian dollars. The training at AIMS, including airfares, is estimated to average about US $4400 per person.

Amended time table and budget

(1 July - 30 June)		US$
1991 -1992	Establishment of collaboration	11,940

	and regional collection.	
1992 -1993	Training of 6x2 collaborators at AIMS	52,800
	Construct and install special equipment in participating countries (seek external funds)	
	Train in remote sensing techniques (to locate suitable corals)	
1993 -1994	Training of 3x2 collaborators at AIMS	26,400
	Continue equipment provision (external funds)	
	Workshop to allow comparison of results	40,000
1994 -1995	As per original concept (Hangzhou 1990)	105,000
1991- 1995	Total	236,140
		(of original 238,000)

4.6 COOPERATIVE STUDIES OF OCEAN DYNAMICS IN THE NORTHWEST PACIFIC

The name of the group activity should be changed from Ocean Dynamics in the Northwest Pacific to Ocean Dynamics in the Western Pacific.

Increased WESTPAC ODC-2 activities should be supported to address climate-related stresses on WESTPAC nations (e.g. drought in Indonesia and Australia).

Recognizing the international efforts to design and implement a global ocean observing system, WESTPAC considerations yield the following recommendations:

(i) Noting great progress in the establishment of sea-level stations in WESTPAC nations, the long-term maintenance of those important time series should be encouraged;

(ii) Noting the importance of long-term observations of ocean thermal structure changes (including SST and thermocline depth) in the WESTPAC region, using such devices and XBTs and thermistor chain moorings, national contributions to this effort should be encouraged;

(iii) Noting also the need for systematic measurements of the strong and variable ocean current systems in the WESTPAC region, it should be encouraged that national contributions to a long-term observing system using modern methods such as acoustic Doppler current profilers (ADCP) and satellite-tracked drifters;

(iv) Sampling for biogeochemical studies should be coordinated with physical measurement programmes whenever possible; and

(v) National studies of western boundary currents should be coordinated, and additional national efforts should be encouraged by WESTPAC.

Activities

Organize a special session on low-latitude western boundary currents at the Western Pacific Geophysical Meeting (Hong Kong, 17-21 August 1992) to accelerate joint activity of the CCCO Pacific Ocean Studies Panel and the WESTPAC-ODC2.
Required budget US$ 13,000

Conduct a workshop along the line recommended here before (or after) the next IAMAP/IAPSO meeting (Yokohama, July 1993)
Required budget US$ 15,000

Support a JECSS-WESTPAC Symposium along the line of recommendations.
Required budget US$ 10,000 for 1993 and 10,000 for 1995

Start a programme of training courses both on cruise and modeling, encouraging bilateral cooperation. Cruise facilities will be provided by USA, Japan and China. Modeling facilities will be provided by China and Japan.
Required budget for cruise US$15,000/yr; for modeling US$ 15,000/yr.

4.7 MONITORING HEAVY METALS AND ORGANOCHLORINE PESTICIDES USING THE MUSSEL WATCH APPROACH

The following comments were made on Musselwatch activities:

(i) Proposed intercalibration exercise did not take place.

(ii) IOC, through the Group of Experts on Standards and Reference Material (GESREM), is preparing a Reference Material suitable for use by laboratories participating in the International Musselwatch programmes.

(iii) The International Musselwatch Programme has started its field-phase in South America and the Caribbean in coordination with the national programmes in North America. WESTPAC collaborators will await the outcome of this study.

(iv) Given the close relationship of their interests it would seem appropriate to have a joint meeting of the Musselwatch, River Inputs and Toxic and Anoxic Phenomena group scientists from the WESTPAC, at a convenient time in 1993.

(v) Since changes in personnel have occurred, a new listing of country focal points should be prepared.

Other issues discussed include atmospheric transport of pollutants, interaction with other regional pollution programmes, economic impacts of marine pollution and coastal margin fluxes.

The Workshop recommended that:

(i) Recognizing the importance of atmospheric transport of pollutants, this be included in marine pollution research and monitoring (MPRM) network activities. The problem should be reviewed and a programme developed for consideration at the next WESTPAC meeting (Prof. Jing Zhang to coordinate);

(ii) a closer interaction between the WESTPAC marine pollution research and monitoring, and other WESTPAC programme components;

(iii) country focal points for MPRM activities be designed; the list must be kept up to date so that progress and problems can be discussed on a wider basis;

(iv) WESTPAC MPRM collaborators prepare materials for presentation to national planners/decision makers on the socio-economic impacts of marine pollution;

(v) the toxic and anoxic phenomena group and the MPRM network should work more closely on the possible sources of triggers for algal blooms;

(vi) coastal margin fluxed of materials be considered as a future study area for the MPRM network.

4.8 CO-OPERATIVE RESEARCH OF THE CONTINENTAL SHELF CIRCULATION IN THE WESTERN PACIFIC

Since the implementation plan was adopted in October 1990, much progress has been made in several of the sub-regional seas identified as potential sub-projects. Following are the summary of the workshop results:

(i) Gulf of Thailand - Coordinator: Dr. Mahanop Bunpapong

Thailand-Norway bilateral study;

A proposed project may be partially funded by Japan through a Japan-Malaysia bilateral study of the Malaysia Peninsula which will cover the southern part of the Gulf mouth;

Swedish International Development Authority (SIDA) has expressed its interests in the region and some funds may be sought for both Thailand and Vietnam;

Participating countries are Thailand, Japan and Malaysia and Vietnam has indicated its interests in the projects.

(ii) Malacca Strait - Coordinator: Dr. Abdul Aziz Ibrahim

The project name was defined as Malacca Strait and the Andaman Sea. it was proposed to change the name to the above one.

A national project has been funded by Malaysian government. and A Japan-Malaysia bilateral study of Malaysia Peninsula which will cover the Malacca Strait has been proposed. Indonesian scientists expressed their interests in this study.

(iii) Pacific/Indian Ocean through-flow region

Because of the nature of this sub-project, it was suggested that it be transferred to ODC-2, the project on Ocean Dynamics in the Western Pacific.

(iv) East China Sea - Coordinator: Dr. Tetsuo Yanagi

The implementation of the project is underway. Some studies have been carried out, e.g. Chines JGOFS marginal flux study; Chinese shelf circulation study; Japanese JGOFS marginal flux study; Korean Tsushima current study and China-Japan bilateral Kuroshio study, etc.

(v) Sulu Sea - Coordinator: Commodore Entato B. Feir

The scientists from Philippines, Indonesia and China indicated their interests in the study. Further funds to support implementation in this area should be seek by participating institutions.

(vi) Gulf of Tonkin - Coordinator: to be identified

This is a new proposal submitted by Vietnam at this meeting. It was accepted by the workshop. The detail proposal will be developed by scientists from Vietnam with possible co-operation with Chinese scientists.

A training course on numerical modeling on shelf seas circulation was proposed by the workshop. The objectives of this course are to provide scientific knowledge of numerical modeling of shelf seas to the scientists from developing countries and enable them to conduct process-oriented studies using two-dimensional tidal and wind-driven numerical circulation models. The participants of the course should have experience in numerical modeling.

Japan and China expressed their willingness to host this training course, provide computing facilities and to cover part of expenses for instructors and the trainees.

The workshop discussed with appreciation the offers made by Japan and China and decided that the date and venue for this training course.

- The first choice: in Summer 1993 in Tokyo, Japan
- The second choice: Autumn 1992 at Institute of Atmospheric Science. (Numerical studies laboratory Beijing, China)

4.9 ASSESSMENT OF RIVER INPUTS TO THE SEAS IN THE WESTPAC REGION

Some excellent progress has been made on the study of mangrove fluxes, but more work in needed for a good understanding of these systems. Some good data on contaminants in mussels has been produced but this data needs to be related, in some cases, to local geochemistry to clearly determine where pollution is occurring.

Reference methods for measuring contaminant concentrations need continual upgrading. Modelling may be of assistance in coastal pollution studies, but appropriate testing is required.

Estuaries are still a major source of scientific controversy, but some progress has been made on flux determinations.

At the IOC/WESTPAC Workshop on River Inputs of Nutrients to the Marine Environment it was reported that:

A laboratory intercalibration exercise for nutrients willecarried out in 1992; and

There is a need to encourage national agencies to include nutrients in river water studies.

A joint workshop with the toxic and anoxic phenomena group should be held immediately before the next WESTPAC session.

The following rivers systems/countries have been recommended for inclusion in a WESTPAC programme on river inputs to nutrients to the marine environment.

Russia - Amur River
R. Korea - 5 river systems
Japan - Tama River
China - Qiantang and Jiulongjinag Rivers
Philippines - Pampnga and Pasig Rivers
Thailand - Bang Pankong Mae Klong and Chao Phraya Rivers
Malaysia - Perak and Merbok Rivers
Fiji - Rawa River
Australia - South Johnstone River

Sampling and analytical strategies have been developed and will be tested in the proposed programme.

5. CLOSURE

Dr. J. Baker, Chairman of the International Steering Committee for

the Symposium addressed the plenary session. He expressed his sincere thanks to the members of the Committee and the Local Organizing Committee for their exellent work on preparation and organization of the Symposium since the last session of the IOC WESPAC Sub-Commission, February 1990. He also thanked all participants for their attendance and presentation of scientific papers. He extended his congratulations on the success of the Symposium and expressed the hope that its conclusions and recommendations would provide guidance for the further implementation of WESTPAC programmes.

Professor Su Jilan, the Acting Chairman for the Sub-Commission, speaking on behalf of all participants, expressed gratitude to Dr. Baker for his effective handling of this important scientific event and for his leadership of the International Steering Committee. He also thanked the local organizer and all participants for their support and efforts which contributed to ensuring the success of the Symposium.

The Acting Chairman closed the Symposium at 1730 hours, 6 December 1991.

ANNEX I

PROGRAMME OF THE SYMPOSIUM

MONDAY 2 DECEMBER 1991

0800-0900	Registration	
0900-1030	Opening Session	
	- Welcome Remark:	Dato' Mohd Noordin Hassan, Secretary-General, Ministry of Science, Technology and the Environment, Malaysia
	- Opening Remark:	Dr. Gunnar Kullenberg, Secretary IOC
	- Official Opening:	The Honourable Mr. Peter Chin Fah Kui, Deputy Minister of Science, Technology and the Environment, Malaysia
	- Overview Address:	Prof. John Gray, Professor, University of Oslo, Norway
1030-1100	Coffee Break	
1100-1230	Plenary Session - Keynote Addresses Chairman: Dato' Mohd Noordin Hassan	
	Ocean Variability and Links With the Climate Change: Prof. Tomio Asai	
	Causes and Impacts of the Sea Level Change: Prof. Klaus Wyrtki	
1230-1400	Lunch	
1400-1530	Session on IOC/WESTPAC Sub-Commission Programmes Chairman: Prof. Su Jilan	
	A Summary Presentation of IOC/WESTPAC Sub-Commission Programmes: Respective Project Coordinators	
1530-1600	Coffee Break	
1600-1730	Plenary Session - Keynote Addresss (Cont.) Chairman: Prof. John Gray	
	Managing the Marine Environment: Dr. Abu Bakar Jaafar	
	Provision of Adquate information Base for Ocean Development: Dr. Gunnar Kullenberg	
1745-1900	Special Meeting for WESTPAC Workshop Chairman	
2000-2200	Welcome Reception	

TUESDAY 3 DECEMBER 1991

0900-1030	Plenary Session - Scientific Session 1A on Causes and

Impacts of Sea Level Change
Chairman: David Pugh

West Pacific Marginal Seas in Last Glaciation: Paleogeography and its Environmental Impact:
Prof. Wang Pinxian

Global Rise in Sea Level and Coral Reef Islands:
Prof. David Hopley

Halocene Sea-Level Changes in the Malay-Thai Peninsula, A Tectonically Stable Environment:
Prof. H. D. Tjia

1030-1100 Coffee Break

1100-1230 Scientific Session 1B on Causes and Impacts of Sea Level Change (Cont.)
Chairman: Dr. G. Kullenberg

The Circular Propagating Pattern of the Low-frequency Fluctuations of Monthly MSL in the Tropical Pacific and its Correlation with El-Nino:
Mr. Yu Jiye

Detecting Nearshore Wave Climate Changes due to Artificial Sea-level Rise:
Dr. Abdul Aziz Ibrahim

The Reasons of China's Coastal Erosion:
Assoc. Prof. Wu Guiqui

1230-1400 Lunch

1400-1530 Scientific Session 2A on Ocean Variability and Links with the Climate
Chairman: Prof. Zeng Qingcun

Sea Surface Temperature Variations in the South China Sea during the Northern Hemisphere Winter Monsoon:
Dr. Lim Joo Tick and Mr. Tuen Kwong Lum

Asean-Australia Economic Cooperation Programme-Regional Ocean Dynamics Project:
Dr. Ilahude

Numerical Simulation of Ocean Variabilities and Extra-seasonal Prediction of Climate:
Prof. Zeng Qingcun

1530-1600 Coffee Break

1600-1730 Scientific Session 3a on Biogeochemical Processes:
Chairman: Dr. J. Baker

Impact of Chemical Elements to the China Sea via River and Atmosphere:
Prof. Jing Zhang

Chemistry of Asian Wind Dust Transport to the Northwest Pacific:
Prof. Jing Zhang

The Relation Between Phytoplankton Standing Stock and Water Temperature in the Banda Sea and the Seram Sea Eastern Indonesian Waters:

Ir. Agus Sediadi

2000-2200 Cultural Show and Reception

WEDNESDAY 4 DECEMBER 1991

0900-1030 Scientific Session 3B on Biogeochemical Processes (Cont.)
Chairman: Dr. Mohinder Singh

The Global Expansion of Red Tides and Harmful Algal Blooms:
Dr. Donald Anderson

Innoculation and Culture of Pedinonones Noctilucae, a Symbiont of Noctiluca Scintillance of Gulf of Thailand:
Prof. Tomotoshi Okaichi

Changes in Phytoplankton Population in the Chao Phraya estuary, Thailand, during the Eutrophication Mechanism Studies:
Prof. T. Piyakarnchana

1030-1100 Coffee Break

1100-1300 Special Scientific Session on Western Boundary Currents hosted by CCCO Pacific Panel:
Co-Chairmen: Dr. D.X. Hu and Dr. T. Yamagata

Western Boundary Currents in East of the Phillippines:
Dr. D.X. Hu

On-going and Future Programmes on the Study of Arlindo:
Dr. A.G. Ilahude

Low-Latitude Western Boundary Currents in the Pacific Ocean:
Dr. R. Lukas

Interdecadal Natural Climate Variability in the Western Pacific and its Implication in Global Warming:
Dr. T. Yamagata

The Surface Circulation of the Japan Sea:
Dr. J.H. Yoon

1300-1400 Lunch

1400-1730 Workshops/Technical Sessions on IOC/WESTPAC Projects:

Toxic and Anoxic Phenomena Associated with Algal Blooms:
Chairman: Dr. T. Okaichi

Recruitment of Penaeid Prawns in the Indo-western Pacific Region:
Chairman: Dr. Derek Staples

Paleogeographic Mapping:
Chairman: Dr. Robert Burne

Margins of Active Plates:
Chairman: Prof. Hideo Dagami

Climatic Records in Long Lived Corals:
Chairman: Dr. J. Baker

Cooperative Studies of Ocean Dynamics in the Northwest Pacific:
Chairman: Dr. T. Yamagata

Monitoring Heavy Metals and Organochlorine Pesticides using the Mussel Watch Approach:
Chairman: Dr. Suthip

Cooperative Research of the Continental Shelf Circulation in the Western Pacific:
Chairman: Dr. Dunxin Hu

Assessment of River Inputs to the Seas in the WESTPAC Region:
Chairwoman: Prof. Manuwadi Hungspreugs

THURSDAY 5 DECEMBER 1991

0900-1200 Workshops/Technical Sessions on IOC/WESTPAC Projects (cont.)

1200-1245 Plenary Session - Keynote Address
Chairman: Capt. Mohd Rasip bin Hassan

Biogeochemical Processess:
Prof. Jean M. Martin

1245-1400 Lunch

1400-1730 Poster Session

Algal Flora of the Great Barrier Reef:
Drs. I.R. Price and F.J. Scott

Developing Marine Science Materials for South Pacific Schools:
Dr. S.M. Ritchie

Giant Clam Mariculture:
Dr. J.S. Lucas

Geographic Information Derived from Aerospace Data on Pacific Tropical Low Islands, Reefs and Lagoons:
Dr. L. Loubersac

Video Show

Artificial Reefs:
Department of Fisheries, Malaysia

Field Visit to Muka Head Research Station for Marine and Coastal Studies

2000-2200 Symposium Dinner Hosted by Ministry of Science, Technology and the Environment, Malaysia

FRIDAY 6 DECEMBER

0900-0930 Plenary Session - Keynote address
Chairman: Mr. Mazlan Bin Jusoh

Management Needs:
Mr. G. Kelleher (presented by Dr. J. Baker)

0930-1030 Scientific Session 4A on Managing the Marine Environment:
Chairman: Commodore Renato B. Feir

The Importance of Ecosystem Diversity and Stability to Coral Reef Management:
Dr. J. van der Land

Management of Marine Environment:
Dr. J.K. Patterson Edward

Artificial Reefs - an Emerging Technology for Environmental Management:
Raja Mohd Noordin, Choo Poh Sze and Ismail Ishak

1030-1100 Coffee Break

1100-1215 Scientific Session 4B on Managing the Marine Environment (cont.):
Chairman: Prof. T. Piyakarnchana

Space Missions in Oceanography during the 1990's and Beyond:
Dr. Willian Patzert

Recent Trend in Petroleum Contamination in the Western North Pacific:
Dr. Katsuhiko Fushimi

Geographic Information Derived From Aerospace Data For Land Nd Sea Resource Surveys, Evaluation and Management on Pacific Tropical Low Islands, Reefs and Lagoons:
Dr. L. Loubersac

1215-1445 Lunch

1445-1530 Workshop Reports:
Chairman: Dr. J. Baker

A Report on the Workshops held during the symposium by Prof. Su Jilan, WESTPAC Acting Chairman

1530-1730 Concluding Session
Symposium Synthesis and Panel Discussions:
Chairman: Captain Mohd Rasip bin Hassan
By Keynote Speakers

Closing Speech - Dr. J Baker, Chairman, International Steering Committee for Second WESTPAC Symposium

Official Closing - Prof. Su Jilan, WESTPAC Acting Chairman

ANNEX II

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ANNEX III

ABSTRACTS OF SCIENTIFIC PAPERS

CONTENTS

VARIATIONS OF SEA LEVEL AND SEA LEVEL TREND AND THEIR POSSIBLE CAUSES

WOLFGANG D. SCHERER

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Relative sea level, i.e. sea level relative to a fixed bench mark on land, of the oceans varies over a wide range of space and time scales. Changes in climate, tectonics, post-glacial rebound, subsidence, uplift, ocean circulation, atmospheric pressure, salinity and temperature, and the volume of sea water are all causes for changing sea level. Sea level has not been constant throughout earth's history and it is changing now. The forces changing sea level not only vary greatly with time and space but their relative importance also change with time.

Sea level change, its amplitude and spacial variation are presented ranging from seasonal to interdecadal time scales. The variability of sea level trends both in space and time are also examined. An assessment of the status and the capabilities of new technology of tide gauges and related instrumentation is presented. Various analysis techniques and approaches to examine sea level variability, sea level trends and its variability will be stressed. Analyses of long term global sea level data are compared with global sea level model predictions.

THE CIRCULARLY PROPAGATING PATTERN OF THE LAW-FREQUENCY FLUCTUATIONS OF MONTHLY MSL IN THE TROPICAL PACIFIC AND ITS CORRELATION WITH EL NINO

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The long term time series analysis of the SST (Sea Surface Temperature) in the eastern equatorial Pacific Ocean and the monthly MSL (Mean Sea Level) in the tropical Pacific Ocean is conducted. Their quasiperiodic and low frequency oscillation features are revealed. The significant periods of low frequency fluctuations for monthly MSL in the area of 20N--20S are between 43.5 months and 50.0 months, approximating closely to 47.6 months which is the significant period of SST in the eastern equatorial Pacific Ocean. The low frequency fluctuations of monthly MSI in the tropical Pacific Ocean appear to have a anticlock wise circularly propagating pattern, which is the eastern Pacific Ocean (off shore of Mexico)-- the area of NEC(North Equatorial Current)--the western equatorial Pacific Ocean-the area of NECC(North Equatorial Counter Current)-- the eastern equatorial Pacific Ocean. The phases of the pattern are corresponding to that of El Nino cycle. Based on the results above, a basic model is established with stepwise regression method, which can forecast El Nino events by the variations of monthly MSL at a few stations in the tropical Pacific Ocean 4 months ahead. The correlation coefficient between the forecasted series and observed one is 0.89.

In addition, some conclusions indicate that the intensification of westward transport by NEC may be the initial reason causing the accumulation of warm

surface water in the western equatorial Pacific Ocean. It is also shown that the low frequency fluctuation of MSL in the southern Pacific perhaps follows an anticlock wise circularly propagating pattern, i.e. the eastern Pacific Ocean (off shore of Peru)--the area of SEC(South Equatorial Current)--the western equatorial Pacific Ocean (around the Coral Sea)-- the area of SECC (South Equatorial Counter Current)-- the eastern Pacific Ocean.

DETECTING NEARSHORE WNCE CLIMATE CHANGES DUE TO "ARTIFICIAL" SEA-LEVEL RISE

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Malaysia is considered as a maritime country, being surrounded by seas - South China Sea to the east, Straits of Malacca to the west, and Straits of Johor at the southern tip of physical and economic developments of the country are dependent on parallel developments of seafront infrastructures as ports and harbours.

Most of Malaysia ports are located near the river mouth e.g. Port Kelang, Port of Penang, and Port of Perlis. The accessibility of these ports are made possible by the creation and maintenance of navigation channel by dredging or deeping the existing seabed.

The main impact of this dredging work is on the pattern of siltation/ depend to some extent on the magnitude of approaching waves. In turn, waves capability to move sediment depends on the water depth. The dredged channel is analogous to the increased water depth, i.e. in the present investigation analogous to an "artificial" sea level rise. With deeper water (as a direct result of dredging) the waves would break or dispense its destructive energy further onshore with costly results. Several severely eroding coastlines and structure failures in Malaysia are traced to this relatively unknown phenomena.

A relatively simple method has been devised at Coastal and Offshore Engineering Institute, UTM to check this possiblilty. A refraction model has been applied at several locations in Malaysia and the results are very encouraging, and discussed in details in this paper. The same technique can be applied to project the potential impact of sea level rise on coastline and properties due to direct seabed lowering, or relative sea level rise.

SEA-SURFACE TEMPERATURE VARIATIONS IN THE SOUTH CHINA SEA DURING THE NORTHERN HEMISPHERE WINTER MONSOON

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Concerted efforts have been made by the Malaysian Meteorological Service since the early 1980s to build an adequate Marine meteorological data base for South China Sea and the Straits of Malacca. These efforts were and continued to be concentrated on the expansion of the WMO/IOC Voluntary Observing Ship Scheme, cooperation with oil companies in the acquisition of oil-platform data, and gaining access to data acquired by scientific expeditions such as the Matahari Expeditions conducted jointly by the University of Agriculture, Malaysia and the

University of Kagoshima, Japan. The data base provides the basis for a preliminary study on the sea surface temperature (SST) variations in the South China Sea and their link to the weather and climate of Malaysia.

This study reveals that there are marked spatial and temporal variations of SST in the equatorial South China Sea during the northern hemisphere winter monsoon. Of particular interest is the appearance of a relatively strong SST gradient is forced to undergo significant changes corresponding to the surge-lull cycles of the monsoon. These intraseasonal SST variations appear to induce intensity changes in the near-equatorial through which in turn cause corresponding fluctuations in the monsoonal rainfall over East Malaysia (in Borneo). Similarly, examination of the interannual SST variations associated with the 1982/83 and 1986/87 El Ninos indicates that such variations also coincide with or link to intensity variations of the near-equatorial trough and the winter monsoonal rainfall over the Borneo Island.

SEA SURFACE TEMPERATURE WARMING OF KOREAN WATERS DURING THE LAST CENTURY

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Sea Surface Temperature warming up was examined in Korean waters, 33°N - 37°N and 125°E - 131°E, for a century period of 1881-1990. Mean values of February and August at one degree grid for five data sets, 1881-1910, 1911-1925, 1926-1940, 1961-1975 1976-1990 were chosen and they were shown 2°C warming up in February and 1°C warming up in August during the last century, assuming 1.5°C warming up in general.

THE RELATION BETWEEN PHYTOPLANKTON STANDING STOCK AND WATER TEMPERATURE IN THE BANDA SEA AND THE SERAM SEA EASTERN INDONESIAN WATERS, INDONESIA

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Chlorophyll and water temperatures measurements were made at 21 stations in the Banda Sea and the Seram Sea in January to February 1986. The mean value of chorophyll-a was higher in the Banda Sea than in the Seram Sea. The maximum concentration of chlorophyll-a was found at 75 meters depth in the Banda Sea (1.12 mg/l.) and 50 meters depth in the Seram Sea (0.50 mg/l.). The mean temperature of both seas were found relatively the same condition at the surface to 100 meters depth (24°C- 29° C.). In the Banda Sea, the genus of phytoplankton was dominated by Chaetoceros and in the Seram Sea was dominated by Lithodesmiumpy. It seems that the relation between the phytoplankton standing stock and the water temperatures in both seas were unsignificant.

ZONAL DISCREPANCE OF IODINE IN THE WESTERN PACIFIC - OCEAN AND ITS ADJACENT AREAS

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Analysed ocean waters collected from 29°N to 69°S. The results show that the distribution of inorganic iodine concentration appears higher on the southern than the northern of the equator. However, it gets obviously risen when reached into the East China Sea. In a warm eddy of the Kuroshio, it can be up to 193 ppb, which has never be reported before.

There is a tendence of decrease of iodide concentration on both sides of the equator and it approaches the minimum on the southern of Antarctic convergence though it is much high in the Kuroshio of the East China Sea, and the possibility to trace the Kuroshio with the change of iodine speciation is proposed.

Organic iodine concentration keeps constantly to the value of about 5 ppb. And the cause of above zonal discrepances are discussed with chemical, biological and hydrological elements.

ISOLATION AND CULTURE OF PEDINOMONES NOCTILUCAE A SYMBIONT OF NOCTILUCA SCINTILLANS OF GULF OF THAILAND

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Noctiluca scintillans is the one of the common species which causes red tides along the coast of temperate and tropical water areas. Discoloration of sea water due to N. scintillans shows pinkish red in temperate water area but the blooming in tropical Westpac area is accompanied with green colour due to the symbiosis of Pedinomonas noctilucae Sweeny, Prasinophyceae, to N. scintillans. B.M. Sweeny (1971, 1976, 1978) studied the biological features in details and tried the culture of P. noctilucae isolated from the host have been remained to be solved as future problem.

The present authors isolated P. noctilucae from N. scintillans collected at the Gulf of Thailand on August 1989, and succeeded in culture using ESM medium fortified with high concentration of NH_4CI and K_2HPO_4 and adjusted the pH to 4.5 at 28°C. In addition of 1 mM NH_4CI and 1 mM K_2HPO_4 to ESM medium. P. noctilucae increases more than $200x10^3$ cells mL^{-1} after about 2 weeks and is preserved for 2 years in host free condition. The composition of culture medium were suggested by the chemical analysis of body fluid of N. scintillans of-both Japanese and Thailand samples. The biological characters reported by B.M. Sweeny were also confirmed with SEM observation. The result of the study seem to encourage the studies on host-symbiont relationship cancerning with marine phytoflagellates.

CHANGES OF CHEMICAL COMPONENTS AND ENERGY, CHARGE OF MARINE PHYTOFLAGELLATES DURING THEIR LIFE CYCLE

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The changes of cellular contents of adenosine triphosphate (ATP) in Chattonella antiqua were examined through the growth process in laboratory culture using ESM enriched seawater. Carbon, nitrogen and phosphorus in the cell were also analysed.

Cellular contents of ATP decreased in several hours after innoculation to fresh

medium, then rapidly increased at early log phase of the growth process (23-30 pg. ATP. $cell^{-1}$). After the middle of log phase ATP level decreased and reached to constant from the late log phase to the resting stage (5-10 pg. ATP. $cell^{-1}$).

The decrease of ATP after innoculation seemed to be due to the lack of extracellular organic materials in fresh medium. The addition of both low and high molecular fraction obtained by the dialysis of C. antiqua culture medium of early resting phase of the growth increased cellular ATP contents in early log phase. Energy charge (EC) decrease from 0.63 to about 0.5 at log phase and recovered at log phase.

Lag phase in phytoplankton culture is the period to produce extra- cellular organic materials to adapt to fresh medium consuming cellular ATP.

SUSTAINABILITY FOR DEVELOPMENT AND THE ENVIRONMENT

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Questions concerning an operational definition of sustainability have been raised on several occasions following release of the wording provided by "The World Commission on Environment and Development" (WCED), "Our Common Future".

As part of the concept of "environmentally sound and sustainable development" (ESSD) the WCED defines "sustainable development" as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". By itself, the latter statement is unbounded and involves an appeal to "inter-generational equity" with the consequent implicit assumption that increasingly effective and efficient technological adjustments regardless of the quality of available resource base.

The relationship between sustainability and development has been addressed on any occasions. The problem involves the necessity for an accommodation between the requirements of potentially unlimited growth and energy use with the dictates of a finite system, the second law of thermodyamics and the inevitability of increasing disorder (entropy).

In a gross sense, the question of specifying "environmentally sound" involves definition of the extent to which the global ecosystems, which are themselves "counter entropy", can accommodate the effects of increased entropy without terminal break-down. The phrase "absorptive capacity of the environment" is thus identical to the idea of "environmentally sound development". The items which is missing from most attempts to develop a definition combining "environmentally sound" with "sustainability" relates to the concept of "balance" between the undesirable effects of development and the continuing requirement for the expression of a competent biosphere.

The words "environmentally sound" have intuitive appeal but they do not suggest immediately operational or measurable criteria for use as the basis for a quantifiable definition. The concept of "sustainable development" should be more carefully examined in order to provide an operational definition that will permit definition of movement towards or away from goal of ESSD.

OCEANOGRAPHY FROM SPACE IN THE 1990'S

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During the 1990s, the space agencies of Canada, Europe, Japan and the United States will launch a constellation of ocean-related satellite missions. These space-based oceanography missions will collect global data that will be used to study ocean physics, air- sea interactions, marine meteorology, biology, sea ice and their broad range of interdisciplinary problems. These ocean satellites have been planned to overlap in time and space with two major field programs, the World Ocean Circulation Experiment and the Tropical Ocean Global Atmosphere Program. Together, these satellite missions and in-situ experiments will provide the international ocean science community with a bonanza of unique data. The resulting scientific studies are to provide a revolutionary new understanding of the Earth's ocean atmosphere cryosphere biogeochemical climate system.

Measuring near surface vector winds over the global oceans, a scatterometer is already collecting data from a C-Band sensor on board the European Space Agency's (ESA) ERS-1 mission. ERS-1 will be followed by ESA'sERS-2 in 1994. Next to fly will be NASA's Ku- Band Scatterometer (NSCAT) aboard the Japanese Space Agency's (NASDA) ADEOS satellite in 1995. ADEOS will be followed in the late 1990s by ADEOS-2 with the possibility of carrying another NSCAT sensor.Thus, if all goes well, oceanographers and meteorologists can look forward to a decade of scatterometer measured vector winds over the Earth's oceans.

The flight of altimeters for ocean circulation studies have begun with ESA'sERS-1; soon to be joined by the joint US/French NASA/CNES TOPEX/POSEIDON advanced altimetric mission in mid 1992. Beginning in 1994, the US Navy plans a series of three GEOSAT Follow-On altimetric missions. Next will comes ESA'sERS-2 mission in late 1994. At the end of the decade, Nasa is considering another TOPEX/POSEIDON-class mission. The overlapping in time of altimetry and scaterometry missions will allow studies of the ocean circulation and its primary driving force, the surface winds.

For sea ice studies, a variety of Synethetic Aperture Radars (SARs) are planned. ESA'sERS-1 carries a C band SAR. In 1992, NASDA will fly a L band SAR on board JERS-1. Next will be ESA'sERS-1 FOLLOW ON, ers-2, in 1994. In 1995, Canada RADARSAT will fly another C Band SAR. At the end of the decade, ESA plans to fly another C Band SAR. During this decade, the passive microware SSMI sensor on board the DMSP satellites will also be collecting ocean and ice data. Polar

oceanographers will have an unprecedented day night, all weather view of the ice covered oceans.

An ocean colour sensor for the study of ocean productivity will be flown on board the US SeaWiFS mission in 1993. Sea WiFS will be followed by the OCTS sensor on board the two NASDA ADEOS spacecrafts in 1995 and the late 1990s. Also ESA will fly the MERIS sensor in the late 1990s. These measurements of ocean productivity studied in concert with altimetry and scatterometry data and sea surface temperatures measured from the NOAA operational satellites will allow important studies of the thermal and biological response of the upper ocean to wind forcing and ocean circulation. For oceanographers, this will be a busy and exciting decade of "Oceanography from Space".

MONITORING SEAWATER QUALITY IN FOUR CHINA'S SEAS AND REVISION OF NATIONAL MARINE WATER QUALITY STANDARD

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In order to effectively manage marine water quality in the China's seas, Chinese Government has issued The Environmental Protection Law of the People's Republic of China, The Water Pollution Protection and Treatment Law of the P.R. China, The Marine Environmental Protection Law of the P.R. China, etc, and a series of standard of Water Quality Standard for Fisheries etc.

The paper will introduce the marine nature environment and behaviour of Seawater in the near China Seas, estimates the state of seawater quality since the implementation of Marine water quality standard from 1982. The water quality is still good in most near China seas, except some waters in river mouths and harbours where there are a developed industry and density population. A comprehensive assessment on water quality will be also made for Four China's Seas. The pollution in China coastal waters derives primarily from organics, petroleum and eutrophication with heavier in the south, lighter in the North, and much serious in the Middle region. The cause, distribution and trends of the pollution will be also discussed.

This paper will also explain reasons of revision of national marine water quality standard which are resulted from the development of scientific research of water quality criteria and water environmental management regulation, principles, such as a scientific principle based on water quality criteria, seawater function classfication based on the guranting whole marine environment quality, and a principle of overall balance utilization, contents of revision including monitoring items and standard values and relative analytical and monitoring methods as well as management implementation.

The revision will be better to be used to prevent and control seawater quality in the China's seas, ensure human health, preserve marine biological resources, keep marine ecological balance, pledge proper development and utility of the seas, provide a standard for the environmental assessment, and satisfy a request of environment administration.

RECENT TRENDS IN PETROLEUM CONTAMINATION IN THE WESTERN NORTH PACIFIC

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The distributions of floating tars, dissolved petroleum hydrocarbons, oil film and floating plastics have been investigated on the basis of the data obtained in an operational survey of background marine (petroleum) pollution in the seas around Japan and in the Western North Pacific which has been conducted by the Japan Meteorological Agency since 1977.

A heavy tars contaminations was observed in the late 1970s in the north-western margin of the western North Pacific. The high level of tars pollution in the regions of the Kuroshio and its counter current markedly decreased since 1980.

Relatively high contaminations of petroleum hydrocarbons appear in the areas north-east of Japan and in the south sea of Japan. The concentration in the surface water in the western North Pacific did not show so clear decreasing tendency as tars contamination.

In the latter half of the 1970s, oil film has been observed frequently, but it is seen a few times in recent years.

Polystyrene foam plastics comprise most of the floating plastics in the western North Pacific. Others are vinyl chloride, other kind of plastics and fishing gears. The high contamination mainly occurs in the seas around Japan and it spreads over the regions of the Kuroshio and its counter current as in the case of tars. The temporal trend towards a decreasing level of floating plastics was not detected, however, it is noticeable here after since the garbage control of MARPOL 73/78 became effective in 1988.

HEAVY METALS IN MUSSELS OF THE KOREAN COASTAL WATERS IN 1990

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Mussels samples were collected at 16 sites along the Korean coastlines during June-July 1990 for monitoring heavy metals. 13 elements determined are Al, As, Cd, Cu, Cr, Fe, Mn, Ni, Pb, Hg, Sr, Ti and Zn. In South Korea dominant mussel species were Mytilus edulis galloprovincialis and Mytilus coruscus. In the present study, Masan Inner Bay which is one of the polluted areas in Korea showed the highest contents of Cu, Zn, Mn, Ni and Cr in mussels. In the Masan Bay, the Cd, Cu, Mn, Hg and Zn contents in mussels decreased with increasing distance from the head of the bay. Highest contents of Cd and Fe were recorded in mussels of the West Coast

sites while those of As and Hg were shown in mussels of Sokcho area in the East Coast. Compared with the previous data, no indicator of significant increase in heavy metal content in mussels was given.

MATHEMATICAL MODELLING AND REMOTE SENSING METHODS FOR ASSESSMENT OF RIVERINE POLLUTION INPUTS TO THE SEA

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In order to estimate riverine inputs of pollution to the sea the mathematical modelling and remote sensing methods seem to be quite useful. The main results obtained in using these methods in the framework of the project assessment of riverine pollution inputs to the sea of Vietnam 1991-1995 for the last years will be presented.

Firstly, hydraulic and turbulent diffusion equations describing water flow and distribution of suspended materials in coupling river and sea area is solved by numerical methods. Effects of tide motion, wind stress, river current and batometry of the basin bottom are taken into account.

Secondly, a digital image processing method cooperated with visual interpretation has been used for classification of turbidity/suspended sediment, its distribution and transport direction in the sea area of river mouths.

The results connected with the Red River and the Mekong both by mathematical modelling and remote sensing methods will be shown.

THE REASON OF COASTAL EROSION IN CHINA

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Chinese coastal line is not only long but also with a great variety of forms, which has a great significance for developing national economy, foreign trade, strengthen national defense and tourism, Due to various reasons, it has been undergone various historic changes. Some sections have been silted up, some have been eroded down. All these phenomena have already been considered by the scientists and departments concerned. The reasons :

1. The coastal erosion caused by the decrease of the amount of river sand.
2. Coastal erosion caused by man-made factors.
3. Coastal erosion caused by special dynamic conditions.
4. Coastal erosion caused by relative sea level rise.

VARIATION IN THE MACROBENTHIC POPULATION ALONG ESTUARIES IN SELANGOR, MALAYSIA

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Macrobenthos are organisms which inhabit the bottom of the water column. It includes crustacea, mollusks, polychaeta, echinodermata and insect larvae. Most

macrobenthos have limited mobility and are slow moving so that the the population present will be strongly influenced by the environmental factors. Macrobenthos surveys were carried out along estuaries in Selangor. Grab samples were collected at specific stations along the salinity gradient during high and low water. Samples were preserved in 10% formalin and brought back to the laboratory for identification. The results show that the macrobenthos numbers reduced up-estuary.

MODELLING HYDRAULIC FLOWS IN A TIDAL ESTUARY SOME OBSERVATIONS

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River flows in a tidal reach of an estuary consist of a uni- directional fresh water flow towards the mouth of the estuary as well as an oscillatory component driven by the tide. Data on such flows and model predictions subject to various tidal conditions are needed crucial input to any water quality analysis and prediction.

Direct measurements of tide levels and flows at strategic locations enable one to build simple models to simulate such flow regimes. This paper discusses two methods used for such flow analysis. The first method applies the mass conservation of volumetric flux directly to segments of the river to derive a model of volumetric flux for a tidal cycle. The second method solves numerically a one- dimensional hydrodynamic model for the propagation of a long wave through a shallow water system that conserves both energy and mass.

Comparison between the two methods and their relative merits will be discussed using a tidal estuary in Johor as a case study.

COASTLINE CHANGES OF PENANG ISLAND

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Pulau Pinang is one of the well-developed islands in Peninsular Malaysia. Most of the development is concentrated on the eastern side of the island (Penang Structure Plan. 1987). These developments can result in coastline changes. Beside man-made developments, the coastline also changes through natural erosion and sedimentation processes. The objective of this study is to determine the coastline changes at specific sites between 1959 and 1989 using topographic and hydrographic maps, aerial photographs and social survey. The results indicate that erosion occurred at around the coastal area at Gurney Drive in the northeast coast of Penang, at Batu Feringgi in the north coast, at Mukim sg. Burung in the south-west coast, and at Teluk Kumbar and Permatang Damar Laut in the south coast. The problematic areas-are Gurney Drive and Mukim Sg. Burung. These areas

are exposed to strong winds and waves. The area from Georgetown to Teluk Tempoyak undergoes sedimentation processes. Reclamation occurs here for road and bridge construction as well as housing development. Sedimentation occurs naturally in the mangrove areas.

THE ABYSSAL CIRCULATION IN THE SOUTHERN PHILIPPINE SEA

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Hydrographic cast along two zonal s to 127° ection 12°N and 13°N (longitude from 144°E to 127°E) was made with CTD during February 1987. Their analysis verified the existence of cold and saline bottom water between the Mariana Ridge and the Kyushu Palau Ridge. This result provides an evidence of the inflow to the Philippines Sea through the deep gap called the Yap-Mariana Junction. The properties of deep water are variable in the West Mariana Basin (WMB) while quite homogeneous in the Philippine Basin (PB), in dictating the transitional nature in WMB and older bottom water in PB. A close examination suggests that bottom water in the western part of PB has water properties more similar to those in WMB than the eastern part of PB. This slightly colder deep water with a hundred kilometer scale in the western PB might be related with a broad western boundary current flowing equatorward.

On the other hand, an analysis of simple reduced gravity model was carried out in order to investigate the abyssal circulation of the Philippines Basin and the West Mariana Basin. The model assumes:

1. the inflow through the Yap-Mariana Junction,
2. the existence of the Kyushu-Palau Ridge with a break, and
3. the introduction of horizontal diffusion.

The circulation pattern obtained from this model can account for the distribution of water properties seen in the observation and the existence of the equatorward broad western boundary current.

RIVERINE INPUTS TO THE SEA FROM MALAYSIAN MANGROVES

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This paper outlines a long-term study to establish quantitatively the importance of mangroves to the estuarine and coastal fisheries in terms of the inputs of organic matter and nutrients from the mangrove rivers to the adjacent coastal waters. The mass balance approach was used in the 40800-ha managed Matang mangroves which has a total standing biomass of 8.26 tones of dry matter of which 1.01 million tones is released annually. The amount of macro-nutrients released annually to the Matang mangroves through dead trees litter and slash was estimated to be 656 kg/ha/year. Using the figure of 50% export, the export of

biomass and nutrients from the Matang mangroves through leaf- litter alone is 3.9 and 0.1 tonnes/ha/year respectively. Another way to determine river inputs is by measuring the nutrient levels along the salinity gradient. One set of mixing diagrams for Matang suggest that, over the sampling period, the mangrove estuary functioned as a sink for suspended solids, particulate organic carbon, nitrogen and phosphorus. However, additional sampling over at least a one-tear period is required before any conclusions can be drawn. A hydrodynamics approach involving the monitoring of flow of water and nutrient concentrations through a number of sections across the mouth of an estuary was then adopted in the Merbok mangroves. Data over 45 tidal cycles showed large variability with time and space e.g. the water discharge ranged from 908 to 1243 with a mean of 178 m^3s^{-1}.

DEEP WATER PROPERTIES AND CIRCULATION IN THE WESTERN NORTH PACIFIC

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Circulations of deep water in the western North Pacific are examined from distributions of water properties on potential density surfaces.

The deep western boundary current in the Pacific, which separates from the Circumpolar Current and passes east of New Zealand and the Tonga-Kermadec Ridge, enters the North Pacific through the Samoan Passage. After that, the bottom waters at deeper than 5000 db extend northwestward through the Central Pacific Basin, being steered by bottom topographies, as clarified by many authors. The current at shallower depths, however, take various paths which is different by depths and from the bottom current.

Distributions of dissolved oxygen show that the current from the South Pacific around 4000 db flows northward through the East Mariana Basin after passing the Central Pacific and Melanesian Basins, and do not enter the Philippine Sea. Less oxygen waters than the waters carried by the western boundary current enter the Philippine Sea through the deepest gap (12°N, 139°E) of the Izu- Ogasawara-Mariana Ridge. At about 3000 db, the Philppine Sea opens to the North Pacific at the south of 12° 30'N, and the deep western boundary current flows entirely into the Philippine Sea.

ACUTE TOXICITY AND LEAD ACCUMULATION IN PENAEUS MONODON POSTLARVA

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The acute toxicity test was conducted on postlarva of tiger prawns, Penaeus monodon, to determine the 96 hr LC_{50} values for Pb. With 95% confidence limit the 96 hr LC_{50} values using static and semistatic method were 5.88 $\pm$ 1.39 mg/1 and 5.73 $\pm$ 0.94 mg/1 respectively. Bioaccumulation of Pb in postlarva reached steady state in 10 days with a bioaccumulation factor of 139. Irreversible sublethal effects observed during the bioaccumulation study were growth retardation, black

tail and muscular atrophy. The acute toxicity and bioaccumulation of Pb in the P. monodon postlarva were antagonized by the presence of Ni and Cd.

ON ORIGIN OF THE STRUCTURE OF THE EARTH'S PACIFIC SEGMENT

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The Pacific segment of the Earth has been formed by the tremendous depression of the Pacific and the surrounding movable belt.

The Geologic Map of the Pacific, compiled by the author shows that the Pacific depression is a global geomorphostructure of the central type, having been formed at the early stage of the Earth's development. During all its history it was tectonically active, and, in the same time, it had function of a rigid massif with respect to the surrounding belt. The Earth's crust in the Pacific segment differs both from the continental crust and the crust of the other oceans. Its basement is mostly composed of basic and ultrabasic rocks formed as a result of long multy stage melting of mantle matter and subsequent transformation of the matters generated by melting. The age of the substrate, according to isotopic analysis, is up to 3000-3500 ma. Analysis of thickness and facies of sedimentary and volcanic rocks of the Pacific, along with geomorphological and paleontological data, shows that subsidence and formation of deep depressions had begun in Jura, about 180 ma B.P., and has been going on at present. However, recurrent large-scale liftings and subsidences occurred in the region earlier which becomes clear when analyzing palebiogeography of the surrounding continents.

The Pacific basin is surrounded by the ring-like system composed of tectonic structures forming the Pacific movable belt which had been formed in Pre-Cambrian as a result of breaking-up and processing ancient platform surrounding the Pacific basin.

The peculiarities of the Pacific basin, especially isometric outlines and the presence of the movable belt, indicate the specific conditions of its formation, which differ from conditions the other oceans had been formed under.

Origin of the Pacific basin can be most likely explained by a rare event of cosmic nature. In author's opinion, it was formation of the Earth-Moon system, which can be proved by a number of facts.

FLUXES OF DISSOLVED NUTRIENTS AND PARTICULATE ORGANIC MATTER FROM THE CHAO PHRAYA RIVER INTO THE UPPER GULF OF THAILAND

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Samples of water were taken at station 6 near the Chao Phraya river mouth on 14-15 August, 1989, at two-hour sampling intervals, for the period of 24 hours, and analysed for dissolved nutrients and particulate organic constituents.

Current speeds and directions were also measured continuously at two points during the 24 hours running time. On the basis of the data obtained, the flow rate and the transport rates of each constituent were calculated to show their diurnal variations. The estimated net water discharge rate was found to be 25.7 x $10\,m^3$ /day, whereas the net fluxes of dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP), dissolved reactive silicate (DSI), particulate phosphorus (pp), particulate organic nitrogen (PON), particulate organic carbon (POC) and suspended sediments (SS) were estimated to be 59.9 x 10^3 , 6.4 x 10^3 , 5.8 x 10^3 , 10.4 x 10^3 , 116 x 10^3 , 1.3 x 10^6 kg/day, respectively. Transport of bedload material was not considered.

MANAGEMENT OF MARINE ENVIRONMENT - AN IMMEDIATE NEED

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We are entering a period of Earth's history, when the global environment is changing on a scale and with an intensity that has occured only a few times during the nearly four billion- year span of the existence of life on earth. In the past, such changes were brought about by, for example, gradual tectonic movements and the present period of change is mostly the result of the cumulative effects of over five billion human beings making a living on a planet of finite size and resources. By all indications, the above changes will seriously impair marine biota and some way even precipitate the episode of mass extinction. The oceans which constitute about 70.73% of the earth surface play an important role not only in the sustenance of life processes but also in myriad other ways. In the Indian context, as the potential of living and non-living resources of the EEZ of India is great, management of this marine environment and the resources for their sustained yield is imperative. This paper highlights the major problems and future prospects of management of the marine environment with special reference to Indian waters in detail.

INDICATORS OF NUTRIENT ENHANCEMENT IN PORITES CORES FROM THE NORTHERN GREAT BARRIER REEF

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A five year programme on the northern Great Barrier Reef, in the Cairs region, has suggested a number of geochemical and geomechanical signals which are retained in coral skeletons and are indicative of the nutrient status of ambient waters, at the time of growth. The programme was initiated to attempt to detect anthropogenic influences on nutrient inputs into the lagoon of this part of the Great Barrier Reef. Results to band suggest long-term temporal variability in nutrients. Time series analysis has indicated that this is most closely allied to El Nino - Southern Oscillation events. On the outer shelf, these appear to operate through periodic increases in upwelling, while closer to the mainland the expression appears to be related to runoff. The coral cores provide records for almost 200 years. However, perturbations in the records over the last 30 years appear to be related to anthropogenic influences.

MATERIAL FLUX FROM THE COASTAL SEA TO THE WESTERN PACIFIC REGION

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The strategy for the study on the material flux from the coastal sea to the Western Pacific region. The material injected to the coastal sea from the land can be classified into three groups, i.e. the conservative, non-conservative and rare materials. The key words in the material flux are the current structure and the particles. Some case studies are introduced and some concrete study these are proposed in order to make the total model on the material flux from the coastal sea to the Western Pacific region.

PARALYTIC SHELLFISH TOXINS IN BIVALVES AND THE CAUSATIVE DINOFLAGELLATES

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Bivalves often become toxic by ingestion of toxic phytoplankton occuring in the surrounding water. Food poisoning have been occurred by human consumption of toxic bivalves. Among these poisonings, paralytic shellfish poisoning (PSP) is the most prominent because of its global occurrence, high incidence of fatality and the serious damage it causes to shellfish industries. Five species of dinoflagellates in three genera have been identified as causative organisms of PSP. There are many reports on toxins they produce as well as their taxonomy and ecology. These studies revealed that PSP toxins consist of various components which are derivatives of saxitoxin (STX). Toxin profile reported for various strains of dinoflagellates Suggests that it is specific to each genus the dinoflagellate belongs. Main toxins in the genus ilexandrium are reported to be gonyautoxin (GTX) 1-4 and their N-sulfocarbamoyl derivertives, though the variation has been observed among the species. Most of all the toxins of Gymnodinium catenatum consist of N- sulfocarbamoyl derivatives of GTX 1-4. Pyrodinium bahamens var. compressa shows the characteristic toxin profile which consists of STX, neoSTX and its carbamoyl derivatives. Many data on the toxin compositions of bivalves show that toxin profile of bivalve reflects that of causative dinoflagellates. From these, the causative dinoflagellates of PSP toxins would be assumed by the analysis of toxins in bivalves.

THE HYDROGRAPHY OF *ALEXANDRIUM* BLOOMS IN NEARSHORE COASTAL WATERS

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Several species of the marine dinoflagellate Alexandrium produce potent toxins which accumulate in shellfish and some fish, leading to potentially fatal

episodes of paralytic shellfish poisoning (psp) in human consumers. In southeast Asia, Alexandrium species as well as related dinoflagellates in the genera Pyrodinium and Gymnodinium also cause PSP and occasionally discolored water ("red tides"). There is obviously no single mechanism that underlies the many different red tide or toxicity events, but it is becoming increasingly apparent that much of the variability in the spatial distribution of dinoflagellates is a result of the advection and diffusion of blooms by physical processes. These include wind-driven, buoyancy-driven, and tidally generated motions of the water column. Along the southwestern shore of the Gulf of Marine in the US, outbreaks of PSP are an annual event. A series of hydrographic cruises over several field seasons has documented the importance of a coastally-trapped buoyant plume as a mechanism for Alexandrium bloom development and long distance transport. This paper will describe the relatively simple hydrographic measurements that detected this coastal current, and the manner in which its movement along the coast correlates with local wind stress and with the patterns of PSP toxicity. The concepts and approaches taken in this specific study can be applied to many other regions of the world and to other dinoflagellates as well. It is only with a good knowledge of the local physical dynamics that realistic interpretations of biological patterns in red tides can be made. In many cases, what appears to be a local outbreak of toxicity may in fact be the result of the alongshore transport of a bloom population that developed and accumulated elsewhere.

POSSIBLE ASSOCIATION OF MARINE BACTERIA WITH DINOFLAGELLATES TOXINS IN BIVALVES

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Paralytic shellfish poisoning (PSP) is one of the global problems caused by dinoflagellates. Causative organisms for PSP are several species of dinoflagellates such as Alexandrium tamarense and A. catenella. When these species bloom in the environment, bivalves accumulate toxins by ingesting them. It has been confirmed by many researchers that bivalves become toxic during the bloom of toxic dinoflagellates. In the monitoring survey on the bivalve toxicity and abundance of toxic dinoflagellates on Ofunato Bay during 1980 and 1986, we also confirmed the accumulation of toxin by bivalve during bloom of dinoflagellates. However, we noticed at the same time that these two parameters are not always parallel to each other. Bivalve toxicity often increased significantly under absence of toxic dinoflagellates, suggesting the presence of unknown causative organism(s) other than dinoflagellates. During the period when bivalve toxicity was increasing, we observed that PSP toxins are often detected in the particles with bacteria size in the seawater. These findings suggest that marine bacteria which produce PSP toxins are associated with bivalve toxicity.

A STUDY OF THE SEASONAL VARIATION OF TRANSPARENCY (COEFFICIENT OF EXTINCTION OF LIGHT) IN TUMINDAO CHANNEL

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Measurements of the incident illumination for a period of days at one station in Tumindao Channel were made using the L1-2125B Underwater Photometric Sensor and an L1-185SB Quantum/Radiometer/Photometer. These in situ instruments measure light intensity at standard depths with the help of an underwater cable. The photometer is provided with a cosine corrected sensor which minimize the effect of diffused radiation condition. This enables the equipment to obtain almost accurately the downward radiation impinging flat surface of the probe.

These measurements were done only up to 50 meters and the incident illumination decreases logarithmically with depth and the extends of the photo zone extends beyond the 50 m depth level.

From these values of incident illumination, the coefficient of extinction, K, was computed daily variation of the extinction coefficient for this channel was not significant for all standard depths with respect to time and for all observation times with respect to depth. The extinction coefficient was not also affected by cloud and sea surface condition, current flow and sea surface temperature. A transparency gradient was observed near the surface layer.

EUTROPHICATION TRENDS IN THE WATER QUALITY OF THE CHAO PHRAYA RIVER, THAILAND

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Water quality surveys of the Chao Phraya river estuary (Thailand) were conducted in 1988-1989. Samples were collected and analysed for dissolved nutrients (nitrate, phosphate, ammonium, and reactive silicate) in order to assess the extent of eutrophication trends. Dissolved oxygen in the water was found to be lower than the saturation values for the upper and middle reaches of the estuary, where high inputs of domestic wastes were discharged into the river from the City of Bangkok. Spatial distributions of nitrogen and phosphorus compounds also indicated that anthropogenic sources of these nutrients were in the middle reach of the estuary (stations 3- 5). Ammoniun-N was found to be the major fraction of inorganic nitrogen compounds in the estuary. Higher concentrations of nitrogen and phosphorus occurred in the wet season (August) as compared to the beginning of the dry season (December). The nitrogen to phosphorus ratios were generally below 16 suggesting that the estuary was nitrogen limited system.

SEX RATIO AND SEXUAL MATURITY OF THE COMMERCIALLY IMPORTANT SHRIMPS (PENAEIDAE)* IN LUZON ISLAND, PHILIPPINES

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The data used in this paper are taken from the catch of various fishing gears in Manila Bay/Cavite side, Lingayen Gulf, Tayabas Bay, Paracale Bay and Sorsogon Bay, all in Luzon Island. A total of 17,300 specimens belonging to 12 species under 5 genera of the commercially important shrimps were studied to determine the sex ratio and size at the onset of first maturity. The female-male ratio was determined and the mean carapace length of different shrimps reach sexual maturity and full sexual activity were calculated and were found to vary in different species.

CHANGES OF PHYTOPLANKTON POPULATION IN THE CHAO PHRAYA ESTUARY, THAILAND: 1988-1989

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In studying the eutrophication mechanisms in the coastal zone of the Gulf of Thailand in 1988-1989, the inputs of the Chao Phraya river was selected as one of the studied areas. The changing of the phytoplankton populations in the estuarine region of the Chao Phraya river was observed. The other environmental parameters such as water temperature, salinity, dissolved oxygen, ammonia, nitrite, nitrate, phosphate and silicate were also studied. The samples were taken at nine fixed stations within one day sampling, and at one or two stations for twenty-four hours of every two hours interval. The results clearly indicate that phytoplankton populations were varied with the sampling times and water quality. The numbers of the species compositions in the wet season showed less abundant than in the dry sea9on. The differences were greater at the two-river stations, with low salinity and high turbidity, than the seaward ones. Among the blue-green algae, i.e. Oscilatoria sp. was found in almost all stations during the wet season. Some certain species of diatom such as Bacillaria varians, Rhizosolenia alata were found in all sampling stations in the dry season. The most common red-tide species in the coastal waters of the Gulf of Thailand, Noctiluca scintillans were found more frequent in the wet season samples than in the dry season ones. The daily tidal periods showed strong influences on the phytoplankton abundance and distribution of the Chao Phraya river estuary. Chaetoceros pseudocurvisetum were found more than 90% of the total phytoplankton species compositions in the samples taken during the high tide in August 1989 sampling. In contrary, Rhizosolenia setigera were absent during the low tide of the same period.

THE MID-DEPTH CIRCULATION OF SHIKOKU BASIN AT 1500 M DEPTH MEASURED BY SOFAR FLOAT TRACKING

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Mid-depth circulation of Shikoku Basin was measured by tracking four SOFAR floats drifting at 1500 m layer. Two floats were released on 17 April 1988 at 30° N, 135° 59'E, and tracked for 433 days. Another two were released on 3 November 1988 at 29° 52'N and 133°25'E, and tracked for 234 days. Two floats flowed clockwisely around the Shikoku Warm Water Mass with a diameter of 400 km centered at 31° N and 136° E, The mean drift speed was 4.5 cm s^{-1}. One of the floats showed counterclockwise turnings of about ten times with a period of 5.3 days and a maximum speed of 80 cm s^{-1} in the sea area west to Izu Ridge. In the east to Kyushu, a southward flow of 4 cm s^{-1} drift speed was considered to be a part of the counterclockwise circulation at deep layers along the perimeter of the Shikoku Basin. One float remained for 234 days in a limited area of 100 km by 150 km in the western part of the basin.

ORGANIC CONSTITUENTS OF SEDIMENTS FROM THE CHAO PHRAYA RIVER ESTUARY, THAILAND

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Surface and core sediment samples were collected from various sedimentation environment in the Chao Phraya River, Thailand in 1988-1989. The samples were analyzed for organic carbon, organic nitrogen, amino acids, pheao-pigments, total phosphorus and total sulfide contents. Generally, surface sediments from the Chao Phraya River were found to contain higher contents of all the organic constituents determined when compared with sediments from the Songkla Lake and the Pang-nga Bay areas. Apparently, this is due to higher anthropogenic inputs of organic wastes from the city of Bangkok than less populated areas of Songkla and Pang- nga. The atomic ratios of carbon and nitrogen fluctuated in the range from 7.1 to 13.3. No positive correlations were found between organic carbon, organic nitrogen, total phosphorus and pheaopigments in surface sediments from all stations. These results suggest that most organic matter in these sediments were derived from terrestrial detritus rather than from in situ primary production.

The vertical profile of physical and chemical properties of the Chao Phraya estuary sediments were plotted against depth. Sediment core showed very irregular cyclic stratifications. The upper 50 cm sediments contained several, considerably discontinuous laminae, distinguishable by difference in water contents and porosity as well as in organic matter contents. This pattern can be explained on the basis of relative rates of supply of organic matter and terrigenous materials, due to variations which might cause differences in types and amount of sediment being deposited. The rate of sediment deposition in the estuary was estimated to be about 10 cm/year at station 5.

PRELIMINARY RESULTS ON THE RELATIVE ABUNDANCE, SPAWNING AND RECRUITMENT OF PENAEUS MERGUIENSIS IN SORSOGON BAY, PHILIPPINES

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Penaeus merguiensis locally known as "pasayan" is one of the commercially important shrimp resources in Sorsogon Bay. In 1989 to 1990, it represented about 90% of the gill net catch, 12.0% of the fish corral catch and 1.0 to 5.0% of the mini trawl catch in the area. Minimum size of mature samples has a carapace length of 22 mm and size at full maturity is between 30-31 mm carapace length. It spawns throughout the year as shown by the presence of mature samples from the catch of gill nets and mini trawl (17.0- 68.0%) and juveniles from the catch of fish corrals (3.0 -90.0%). The peak of recruitment of juveniles into the estuary and migration of sub-adult to deeper waters varies from year to year and observed to have two peaks. Abundance of catch depends on the period of catching and influence by amount of rainfall.

ARE THERE MAJOR DIFFERENCES BETWEEN THE WESTERN MEDITERRANEAN SEA AND THE JAPAN SEA? A PRELIMINARY INVESTIGATION

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The characteristics of two large Mediterranean Seas (MSs), namely the Japan or Asiatic (AMS) and the Western (WMS), are compared on the basis of a preliminary survey of the papers in our possession. This investigation was rather rapid and not exhaustive, but morphology, meteorology, hydrology and dynamics of these two MSs have striking similarities, and even their difference are instructive. A new insight into these MSs dynamics is proposed. It might bring the various communities of physical oceanographers to pay more attention to the MSs that they are not specifically interested in, and incite them to run their circulation models with other boundary conditions.

THE CAUSE OF BEACH EROSION AT BANG TAO BAY, PHUKET, THAILAND

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The Bang Tao Beach, on the Andaman Seacoast of Phuket Island has been severally eroded in the past few years. This paper has tried to investigate the number of causes of this beautiful beach erosion especially in the field of physical oceanography and sediment transport process in the nearshore region. The remedial methods were also proposed to restore the damage.

BACK-ARC DEPRESSION IN THE IZU-BONIN RIDGE

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Swath bathymetric side-scan sonar (Izanagi) data reveal a precise bottom surface morphology of back-arc depression in the Izu-Bonin Ridge. Fig.1 shows Izanangi back scattering image of 5 km swath width from Hachijo depression. The depression, which is located at several km behind volcanic front, represents N-S elongation. Many volcanic mounts and seamounts are recognized in the depression. A characteristic structure in the depression is a lineament with a general trend of N30° - 40°W. The lineament is represented by normal faults and elongated shapes of the mounds and seamounts. A equivalent lineament is recognized not only in the Sumisu depression approx. 200 km south of the Hachijo depression but also in the Mikura basin 50 km northward. A northward continuation of the lineament is inferred to be identified as far as the Hakone caldera located at northern margin of the Izu-Bonin Ridge, Izu Peninsula. This suggests that a back-arc rifting occurs even in a collision zone between the Izu-Bonin Ridge and the Honshu Arc.

WEST PACIFIC MARGINAL SEAS IN LAST GLACIATION: PALEOGEOGRAPHY AND ITS ENVIRONMENTAL IMPACT

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During the last glacial maximum, the sea level lowering had caused remarkable alternations in configuration and area of the West Pacific marginal seas, With emergence of the vast shelf areas disappeared (e.g. the Yellow Sea, the Java Sea) and numerous small island merged into large ones (e.g. the Philippines). Some marginal seas became enclosed basins (such as the Sea of Japan) or semi enclosed basins with a restricted connection to the open ocean (such as the South China Sea), Sea ice coverage increases significantly in high latitude seas (such as the Sea of Okhotsk).

Meanwhile, the glacial patterns of the oceanic and atmosphere circulation were different from the modern ones. The polar front in the North Pacific, for example, had moved about 10 of latitude southward, and the westerly winds in the Southwest Pacific had shifted significantly to the south. The changes in planetary circulation combined with the local geographic modifications had altered the circulation and temperature patterns in the marginal seas. In the South China Sea, for example, the modern trans- basinal current system was replaced by a semi enclosed circulation pattern and the winter SST was about 6°C lower than it is now with a seasonality (9-10°C) far exceeding that at present (4-6°C).

The reduction of sea area and the changes in sea circulation system had led to major changes in atmospheric circulation and hence, climate on land. As evidenced by the wide-spread eolian deposits and the migration of vegetation zones, continentality and aridity were then strengthened in large areas of Asia and Australia, with winter monsoon intensified and summer monsoon subsided.

The paper reviews available data on paleogeography and paleoenvironment in the West Pacific marginal seas at the last glacial maximum, discusses environmental and biogeographic impact of the paleogeographic modifications, and points gut problems and perspectives of the further studies.

THE USES OF PALAEOGEOGRAPHIC MAPS - WESTPAC PALAEOGEOGRAPHIC MAP PROJECT

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The initial aim of the WESTPAC project is to produce palaeogeographic maps of the WESTPAC region for two Quaternary time slices :- the peak of the last glaciation (c.18,000 years B.P.) and the last inter-glacial (c.125,000 years B.P). The maps will be used as a framework for environmental and climate studies including the testing of global circulation models, and may assist exploration for mineral placer deposits.

The emphasis of the maps will be on the marine realm, the offshore and the coastal zone. the palaeogeographic maps will show the distribution of past environments. There will be accompanying data maps that compile information about sediment type and thickness, water salinity and temperature and other indicators of past climate.

A series of palaeogeographic maps of Australia produced by the Bureau of Mineral Resources provide a guide as to the methodology that could be used for the WESTPAC maps palaeogeography is concerned with mapping the distributions of land and sea through time. It aims to reconstruct the patterns of past environments by integrating sedimentological, biostratigraphic and tectonic information.

The Bureau of Mineral Resources have produced 70 of these time slice palaeogeographic maps of Australia using the following methodology:

i) complication of data sources for each period report, maps, well completion reports;

ii) construction of summary stratigraphic columns and selection of time slices;

iii) preparation of timeslice data maps showing lithology and thickness, paleocurrents, mineral occurrences, outcrop, subcrop, intersections;

iv) preparation of Period structure maps; and

v) preparation of interpretative Palaeogeographic maps.

The palaeogeographic maps have been used primarily for petroleum exploration though they also have applications in mineral exploration. Increasingly, a use for palaeogeographic maps will be inclimate modelling, a palaeogeographic map provides the boundary conditions for global circulation models where the land, sea and mountains are, and then acts as a test of the model when climatically significant facies are plotted - such as coals, evaporites, reefal limestones and glacial tills. By developing our ability to model past climates we will have the confidence to model future global climatic change.

THE EFFECT OF CHEMICAL BARRIER ON TRACE METAL MIGRATION THROUGH THE ESTUARINE AREAS

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The chemical elements delivered in marine environment by river discharge are passing on their way a number of specific areas where the intensity of migration changes considerably. Different metals as well as the species of the same element overcomes these barriers unequally well. The spatial and temporal characteristics of barrier zone depend on environmental factors (hydrodynamical, hydrochemical and biological) and individual element (species) behaviour as well. The removal of humic and fulvic acids, particulate Fe, Cu, Mn and Ni and Dissolved Fe was observed in Razdolnaya River estuary (Amursky zaliv, Sea of Japan) in salinity range 0-5 % mainly. The salinity controlled barrier zone appears to be the most common phenomenon in the world estuaries.

More rare kind of barrier was found out in area of mixing of acldic, volcanogeneous waters of Yuriov River (pH 1.8) with coastal Okholok Sea Waters. Hydrolysis is the main mechanism of iron transformation from dissolved fraction to particulate one after pH increase up to 3-5. The formation of particulate fraction of other elements occured in the sea end of mixing area within pH range 6-8 due to adsorption on the newly formed particles.

THE UPLIFTING OF THE COASTAL, SHIKOKU MOUNTAINS IN THE NANKAI FORE-ARC SLIVER, SW JAPAN

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Nankai fore-arc sliver is one of the typical microplate observed at the northern boundary of Philippines Sea plate. It was formed by oblique subduction of Philippine Sea plate beneath Nankai Trough around 1 Ma Bp. The new cycle of subduction of Philippine Sea plate forced Shikoku coastal area to uplift to be Shikoku coastal mountains.

Stratigraphy and sedimentary facies of the Joyama Formation observed between the foot of Shikoku Mountains and Kochi coastal plain revealed that it was Diluvium fan deposits consisted of red conglomerate facies in the lower part, a large scale fluvial sequence in the middle part and higher terrace deposits in the upper part. Ryup Formation distributed on the consisted of eroded products from the uplifted coastal mountains since 1 Ma BP. Thus, they all Represent molasse sediments formed by early upwarping of the coastal mountains.

Nankai fore-arc sliver has been uplifted repeatedly, and its cycle corresponds well to variation of hot spot activity in Hawaii. The Hawaii episode between 0 and 1Ma Bp and Gardner Pinnacle episode between 13 and 14 Ma BP observed in Hawaiian hot spot by Vogt (1981) correlate with uplifting cycles of Shikoku Mountains. It is therefore, concluded that the uplifting of the coastal mountains is the global phenomena controlled by the mantle convection which may typically appear on hot spot activities. It is also pointed out that paleoenvironmental

studies such as identification of molasse facies are important for recognition of mountain building.

MONITORING ORGANOCHLORINE PESTICIDES IN THE GULF OF THAILAND USING WATCH APPROACH

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Green mussel (*Perna viridis*) collected from the Gulf of Thailand from 1989-1990 were analyzed for the levels of BHCs, DDTs, HCB, aldrin, dicldrin, endrin, heptachlor and heptachlor eposeide.

Seasonal variation made no difference in the residue levels. Concentrations of DDTs, aldrin and dicldrin were higher than the other compounds found. Heptachlor epoxide, endrin were higher than the other compounds fund. Heptachlor epoxide, endrin, and isomers of BHC were not detected in any of the samples investigated. However, the level of organochlorine pesticide residues in green mussel did not exceed the maximum limit for aquatic animals as recommended by the Ministry of Public Health, Thailand.

THE STRUCTURE OF CURRENT ON THE CONTINENTAL SHELF OF SOUTH VIETNAM

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The total currents on the shelf was considered as a combination of tidal current and winddriven current. The tidal current was found by method of harmonic analysis of measured data and solution of system of hydro-dynamical equations. The winddriven current was calculated by Fenzenbaum's method with account of real wind stresses and seabed topography. The maximum current velocity was estimated by approximate solution of nonstable dynamical equations.

The results of investigation are as follows:

1. The maximum current can be caused by wind blowing parallely to coastal line and the minimum current - by wind blowing normally to coastal line.

2. The vertical structure of current depends on the angle between wind direction and coastal line.

3. There are two typical regions of currents on the shelf of South Vietnam : region with strong variability of current (with horizontal gradient of surface current velocity more than 15cm/s/km) and region of relatively stable current (with horizontal gradient of surface current velocity less than 15cm/s/km). The first region is situated nearby the coast and along the sea belt with strong variability of seabed topography. The region is situated in the rest place.

PRELIMINARY STUDIES ON THE PORITES CORALS IN THE DIFFERENT WATERS OF VIETNAM

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Marine area of Vietnam is longer than 3000 km, spans 15 degrees of latitude. Climatic characterists are complicated. Under impacts of different environmental conditions, coral reefs in every water have private feature. It would consider porites corals as a indication for the differency of coral reefs in the waters.

Paper is in focus of the preliminary studies on species composition, growth form, distribution of Porites corals in the marine waters as Eastern coast of central Vietnam, Western coast of South Vietnam, and offshore islands.

OPTICAL PROPERTIES OF WATER IS THE CHAO PHRAYA ESTUARY, THAILAND

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Optical properties of water in the Chao Phraya river estuary were measured at two stations in December 1988 and at seven stations in August 1989. Two underwater photometer with photopic filters, one facing upward and the other facing downward, were lowered step-wise into the water from a small boat to measure downward (E_{dy} and upward (E_{uv}) irradiance for photopic band width at various depths. A portable beam transmission meter with 5 cm path length was also used to determine the photopic total attenuation coefficient (C_v, m^{-1}). The results were plotted in the form C_v or K_{dv} against the concentrations of s suspended particulate matter (SS, mg/1). K_{dv}, m^{-1}, the photopic extinction coefficient for downward irradiance, computed from the distribution data on E_{dv} C_v or K_{dy} was shown to be a linear function of SS concentrations as follows:

$$C_v = 0.32 + 0.51\ (SS) \quad \text{or}$$

$$K_{dv} = 0.40 + 0.057\ (SS)\ ,$$

The ratios E_{uv}/E_{dv} (reflectance) in the surface layer (10 to 20%) were large compared with those usually observed in the seas and oceans (2 to 3%). If turbidity is due primarily to slit or clay, then secchi disc readings (T, m) may be closely related to concentrations of particulate matter. The following empirical formula was then deduced :

$$(SS)\ T = f$$

The value f was found to be about 12 in the middle reach of the estuary.

During the high tide on 17 Aug. 1989, changes in photopic total attenuation coefficient and dissolved oxygen concentration at a 0.5 m depth were recorded continuously from the offshore Pilot Station toward the Chao Phraya river mouth. At about 20 km from the river mouth the water has clarified and the surface water has almost attained the clearness characteristic of the Upper Gulf of Thailand.

RED TIDES AND SEAFOOD SAFETY IN THE PHILIPPINES: NEED FOR A COMPREHENSIVE RESEARCH AND MANAGEMENT PROGRAMME

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The coastlines and off shore waters of the Philippines being quite extensive compared to its land mass, have become significant sources of food and income to a great number of the people. Since 1983, reports of "red tides" in any area in the country usually have caused negative economic impacts to the entire seafood industry. Of equal or importance is the threat to human health of seafoods contaminated with a variety of toxic marine algae and other micro organisms.

The paper presents the status and need of seafood industry in relation to contamination and safety in the Philippines focusing on the shellfish industry and citing scientific bases for management from the culture or harvest site to the consumer site, A practical and viable seafood management program applicable to the Philippines is also being proposed.

BENTHONIC FORAMINIFERA AS INDICATORS OF POLLUTION BY HEAVY METALS, ORGANOCHLORIDE PESTICIDES AND LIQUID HYDROCARBONS

VALENTINA V. YANKO

Foraminiferal monitoring has been done in the different parts of the north western shelf of the Black Sea (depth 5-130m, salinity 1-18‰) (Yanko & Flexer, 1991) and offshore Eastern Mediterranean near Israel (Hadera and Palmahim, depths 2-1300m, salinity 35- 37‰). These areas are affected by pollution from adjacent industrial, domestic and agricultural sources.

Both living and fossil benthonic foraminifera from box cores and sediment cores were studied according to general world-wide accepted methods with some modifications appropriated for the Black Sea (Yanko & Troitskaya, 1987). The following parameters as distribution of foraminiferal species and specimens in space and time, diversity, morphological changes of their tests (deformation, distorted chamber arrangement protuberances on the chambers deformation of aperture) and pyritization in both living and fossil foraminifera have been determined. The relative frequency of foraminiferal benthonic species was treated in a Q- mode factor analysis. The concentration of pollutants in the sediments has been determined using the methods of gas- chromatography, radiograph spectrography, fluorescent and atomic absorption analyses.

Foraminiferal benthonic fauna of the north-western shelf of the Black Sea is represented by 55 species, 3 of them are agglutinated. In investigated areas of the Eastern Mediterranean about 120 mainly calcareous species were found. These fauna are different and it is impossible to estimate the reactions of all species to pollution. That's why only 6 species from genera Ammonia, Porosononion, Quinqueloculina, Miliammina, Discammina, Eggerella were chosed by us as indicators of pollution.

Indicators of heavy metals pollution (especially Pb, Cd, Hg) might be : different kinds of test deformation; decrease of both the sizes of specimens and their abundance and increase of megalospheric forms.

Pyritization in foraminiferal tests corresponds to oxygen-poor hydrogen sulfide-rich environment. In the Black Sea which is contaminated with H_2S bellow depths 130-200 m (widespread point of view, but in many cases we met H_2S even on the depths 20-30m), pyritization in mainly megalospheric specimens Ammonia tepida (Gushman) and Porosononion martcobi Bogdanowicz is widespread.

Low species diversity (Simpson's index 2.3-2.8) and at the same time high specimen abundance of a few tolerant species and dominant significance of microspheric specimens of large sizes with thick wall of test take place in several settings with high concentration of organic carbon (2.4-2.6%) in the sea floor sediments. These places usually are characterized by high pH, low ph, high content of organocloride pesticides and abundance of nutrients for foraminifera. Foraminiferal assemblages very similar to above mentioned ones but more abundant with specimens have been found also in organic rich sediments of some neotectonic uplifts (for example, the Golythyn High in the north- western inner shelf of the Black Sea) which are perspective for oil-gas exploration,

The benthonic foraminifera contents of samples recovered from the polluted by oil sea-bottom sediments don't give any clear picture in regularities of their distribution. As a rule living benthonic foraminiferal fauna is not reach there and mainly it is represented by agglutinated forms (Eggerella scabra Williamson, Discammina imperspica Janko, Miliammina fusca Brady). By the way, dominant significance of agglutinated foraminifera rather often takes place in aquatic settings polluted by different matters.

The use of benthonic foraminifera as indicators of pollution has many preferences on comparison with other organism because foraminifera are shelled organisms of good preservation in sediments; ecological retirement of many species are determined; foraminifera have a short reproductive cycle and can reflect a short-term environmental changes. In addition to, certain foraminiferal assemblages can be used for submarine oil-gas exploration.

SOCIOECONOMIC EFFECTS OF POWER STATION DEVELOPMENT ON FISHERMEN: A CASE STUDY

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The socioeconomic effects of power station development on the fishermen community near the Sultan Salahuddin Abdul Aziz Shah Power Station at Kapar, Selangor and its surrounding area was studied. The results showed that income from fishing decreased since the construction of the power station, five years ago. Studies at control areas at Jeram and Sepang showed that other factors contribute towards the decrease in fishermen income and the amount of their catches. These factors include water pollution from palm oil industries and from piggeny waste exploitation of the fish stock by trawlers, and changes in the river, morphology. However, most of the fishermen (82%) in Kapar felt dissatisfied with the effect of the construction of the power station. About 94% of them felt that the power station affected their livelihood by decreasing their fish catch. Factors related to the construction and operation of the power station such as cutting and reclamation of the mangrove forest, heated effluents from power plants and river changes, were felt to have caused the decrease in fish landings in the areas concerned.

CLIMATIC CHANGES DURING LAST 250,000 YEAR BP AND ITS INFLUENCE ON THE GEOCHEMICAL FLUXES IN SEDIMENTS OF NORTHERN ARABIAN SEA

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Northern Arabian Sea is under the influence of both seasonal upwelling, a result of SW monsoon winds, as well as variable dust loads carried by north westerly winds from neighbouring deserts of Arabia, Mesopotamia and Iran-Makran. Characteristic effects of atmosphere circulation on the geochemical fluxes in sediments of cores from Ocenanic depths off Southern Arabian Coast are seen. Two cores i.e. CD 1715 and CD 1730 collected during R/v Charles Darwin curise 86/17, record a period of accumulation extending to 250,000 year BP.

The oxygen Isotope and Carbonate records of core RC-2761 provide a chronostratigraphic framework for correlation and dating of the cores. These cores were analyzed for their $CaCO_3$ contents, and the Carbonate variation is considered to be reliable for tentative chronostratigraphy to be established.

Sedimentation rates show a steady increase towards north. Major lithogenic fluxes changes down cores (Spatial and temporal) of quartz, dolomite, aluminium, zirconium and titanium all show a significant variation and suggest they are linked to both Climatic Changes and closeness of their source. A mark gradient in overall lithogenic fluxes is seen from north to south, average values are four times higher in north. This trend is persistent throughout the climatic history of last 250,000 years. A north- south change in lithogenic fluxes implies a source in the north and northwest. Northwesterly winds originate from surrounding deserts of Arabia, Mesopotamia, Iran-Makran and transport their dust loads towards the northern Arabian Sea.

Lithogenic flux changes in glacial and interglacial stages indicate a pronounced influence of climatic patterns of neighbouring landmasses. Average values of quartz, aluminum, dolomite, zirconium and titanium fluxes are higher in glacial stages than in interglacial stages, Holocene and interglacial stages 3,5,6 indicate low values of lithogenic flux implying that during these times climate was relatively wet and atmospheric.

NUTRIENTS IN ESTUARIES OF SELANGOR, MALAYSIA

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This study is promoted by concern of nutrient behaviour in the estuaries of Selangor. The objective is to study the distribution of the constituent with salinity along various river estuaries. Five parameters were analyzed, phosporus (P), ammonia (NH_3), silica (Si), salinity and phytoplankton. The river estuaries studied are the Sg. Bernam, Sg. Selangor, Sg. Klang, Sg. Langat and the Sg. Sepang Kecil. The results show these nutrient concentration in the various estuaries are different in concentration along the estuary and with depth. The reasons for these differences are discussed.

GEOGRAPHICAL DISTRIBUTION AND PERIODIC OCCURRENCE OF TOXIC DINOFLAGELLATES IN KOREAN COASTAL WATERS

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The present paper deals mainly with the geographical distribution and periodic occurrence of nine species of toxic phytoplankton such as Alexandrium tamarense, Dinophysis fortii, Gymnodintum mikimotoi, Cochlodinium polykrikoides etc. which caused Paralytic shellfish poisoning (PSP) and fish and shellfish kills in Korean coastal waters and their correlation with the occurrence of PSP in bivalve mollusks.

The principle causes of red tides for Chinhae Bay, up to the last part of 1970s, were mainly diatoms. Since 1981, however the main causative organism have been flagellates such as Gymnodinium mikimotoi, Prorocentrum micans, Heterosigma akashiwo and Cochlodinium polykrikoides.

Alexandrium tamarense responsible for PSP occurred mainly from April to May in large number, and the PSP of the bivalve shellfish collected from the southern coast of Korea was most often detected in the sea mussel mainly during the months from March to May.

Massive losses of cultured yellow tail and sea bream due to Cochlodinium polykrikoides red tides have occured since 1989 in caged fish farms near Chungmu.

COASTAL AQUACULTURE DEVELOPMENT AND ITS IMPACT ON MARINE ENVIRONMENT

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Coastal aquaculture development in Thailand during the past decade has resulted in a sharp increase in aquaculture production especially marine shrimps. Nevertheless the shrimp farming activity itself in turn causes the environmental impacts to the coastal areas. These impacts are for instance the conversion of mangrove into shrimp farms and water quality degradation in the area subjected to the effluent from shrimp farms. The inappropriate shrimp farming technique is an additional factor which accelerate the water quality degradation and eutrophication problems. The paper discusses and suggests several solutions to these problems.

SOME RESULTS OF COMPLEX TIDAL PHENOMENA IN THE GULF OF THAILAND

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In the first part, the complex tidal phenomena in the Gulf of Thailand was presented by modelling. On the basis of these results, by analyzing actual data

in many points of the Gulf and by prediction of tides for the principal points of this area in the nineteen yearly tidal cycle, one practical variant of tidal atlas for the Thailand Gulf was proposed.

In the second part, the propagation of the tidal waves from Gulf of Thailand to the Mekong Delta with many rivers and canals was shown by author in the improved tidal model.

The result are interesting and more real than other studies in which this propagation was neglected.

The further studies of complex tidal phenomena, including the modelling and the actual field data, especially for the tidal current will be necessary with the participation of many countries and the support from international organizations.

OCEANOGRAPHICAL ATLAS FOR USERS IN THE SOUTH CHINA SEA

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A draft oceanographical atlas for users in the South China Sea was established in the Hydrometeorological Service of Vietnam.

In comparison with the others, oceanographical atlas of this region, the new atlas was composed from many actual data, was presented with more details and new results: monthly charts of wind, air and sea temperature, salinity, wind waves and some charts of tides, tidal current and storm surge.

This atlas may be used-in practice, but it is logical that this work may be contributed by other scientists and the support of international organizations may be favorable for the publication.

GEOGRAPHIC DISTRIBUTION OF THE CYST OF TOXIC GYMNODINIUM CATENATUM GRAHAM IN JAPANESE COASTAL WATERS

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Around Japanese coastal waters, eight species belonging in Alexandrium and Dinophysis have been known to produce the paralytic and diarrhetic shellfish poisonings, Recently another naked species Gymnodinium catenatum Graham is recognized to be causative for the paralytic shellfish poisoning in the Senzaki Bay. Unfortunately concerning the geographical distribution of G. catenatum, however, there is no sufficient data in Japanese coastal waters.

Since the cyst of G. catenatum possesses distinct morphology and strong resistance surface resistance in surface sediments, it is easy to recognize its presence in surface sediments. On the basis of these characteristics, I can record some other new locations for this species in Japanese coastal waters. In this paper, I will show a geographic distribution of G. catenatum based on the

previous records and newly found locations of both cyst and motile forms.

These locations are as follows :

Yatsushiro Sea (cyst and motile forms; this paper), Omura Bay (motile form; as Gymnodinium sp. A5 of Iizuka 1979), Aso Bay in Tsushime Island (cyst;this paper), Senzaki Bay in the Sea of Japan (motile form, Ikeda et.al. 1989;cyst, Fisheries agency 1988), Hiroshima Bay (motile form; Hada 1967) in the Seto Inland Sea, Coast of Fukuyama in the Seto Inland Sea (motile form; Ishio et,al. 1977), Tsuda Bay in the Seto Inland Sea (motile form; Yuki and Yoshimatsu 1987), Port of Iyo-Mishima in the Seto Inland Sea (cyst; this paper).

THE COMPARATIVE MORPHOLOGY OF LARVAL DEVELOPMENT ON THE MAIN PENAEID SHRIMPS, PENAEUS CHINENSIS, P. PENICILLATUS AND P. MERGUIENSIS IN CHINA SEAS

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There are more than 80 species of penaeid shrimps have been recorded in chinese waters (J.Y. Liu et al., 1988). About 40 species are considered to be of economic importance. Among them the chinese shrimp Penaeus chinensis, red tail shrimp P. penicillatus and banana shrimp P. merguiensis are the most important species in both shrimp catch and culture.

Because of the great morphological similarity of these three species, especially during their larval and postlarval stages, there are still problems for the shrimp recruitment forcasting. The present study deals with larval and postlarval development of penaeid shrimps in order to provide some basis for distinguishing them. The main larval morphological differences of the three species are concluded as follows :

The three species can not be distinguished during the nauplii stages.

In first zoea stage, Li/L2 * in anttennula is about 1.7-2.0 in P. merguiensis, but in P. chinensis and P. penicillatus is about 1.6; In the second zoea, the supra-orbital spines in P.chinensis are unifurcated, while P. merguiensis and P. penicillatus are bifurcated; In the third zoea, there is no dorso-median spine in the posterior margin of the first abdominal somite (for the second somite, it is minute, if present.) in P. chinensis, but for P. merguiensis and P. penicillatus, there are prominent dorso-median spine on the posterior margin of all abdominal somite.

From the first mysis, P. chinensis different from P. merguiensis and P. penicillatus in having 9 long plumose setae on the exopod of 1-3 pereiopods, for the latter two species, there are only 8; In the second and third mysis, there are 9 long plumose seta on the exopods of third maxilliped and 1-5 pereiopods in P. chinensis and only 8 (or sometimes 7 on the exopod of the third maxilliped in second mysis in P. merguiensis and P. penicillatus. Additionally, P. chinensis has 2 (mostly) or 1 dorsal teeth on the rostrum in third mysis and 2-3 in first postlarva respectively. P. penicillatus and P. merguiensis have only in third mysis and first postlarval.

The present authors have found that P. chinensis is characterized by having a pair of unifurcated supra-orbital spines in the second zoea, which has never been reported in other species of this genus. It is also suggested to use the number of plumose setae on the exopod of pereiopods in mysis stages as a diagnostic

character, which is very reliable in distinguishing P. chinensis from P. merguiensis and P. penicillatus, while this characteristic has been neglected by most of other authors in descriptions. Besides, this difference lasts to the second or third postlarval stage when the exopod of pereiopods begin to degenerate.

P. merguiensis and P. penicillatus can not be distinguished except in the first zoea stages during which Li/L2 is much larger than that in P. penicillatus. As for the other larval stages of P. merguiensis and P. penicillatus, the numerical taxonomy (such as discriminant analysis) is suggested, than it between each of them and P. chinensis, which is similar to the adult.

* There are three seta on the inner side of the second segment of the antennula, Li/L2 refers to the ratio of the distance between the middle seta to the terminal seta and to the basal seta.

PYRODINIUM RED TIDE IN MANILA BAY

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Toxic red fide due to Pyrodinium bahamensa var. compressum first occured in Manila Bay in August 1988 when it left a total of 66 poisoning cases with 4 deaths which all resulted from the ingestion of green bay muscles (Perna viridis) and an economic loss amounting to millions of pesos in less than four months of its occurrence.

Recently, toxic red tide recurred in Manila say after a dormancy of about three years. As in 1988, the toxic red tide started in the coastal waters of the Bataan Peninsula and spread out to the neighboring waters, subsequently affecting the whole bay.

The 1991 red tide in Manila Bay was more intense than the 1988 occurrence in terms of cell density, amount of toxins in shellfish and number of illnesses and deaths.

A detailed account of the two events are discussed in this paper.

A COMPARATIVE STUDY OF THE TRACE METAL FLUXES OF THE BANG PAKONG AND MAE KLONG RIVERS, THAILAND

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Of the four majors rivers draining into the Uooer "Gulf of Thailand, the Bang Pakong and the Mae Klong Rivers were selected for the study of their inputs to the coastal zone because of their distinctive water characteristics. The Bang Pakong River drains acidic soils, while the Mae Klong is slightly alkaline and contains high concentrations of silicate and calcium. Both rivers were studied during the dry and wet seasons. It was found that, in the Bang Pakong, there appeared to be removal of some dissolved trace metals onto particulates in the

low salinity region of the estuary, while this behaviour was not found in the Mae Klong River. In the Mae Klong, the high amount of particulates in the freshwater stretch of the river precipitated quickly in the low salinity region.

IMPACT OF CLIMATE CHANGE ON COASTAL RESOURCES AT SURAT THANI, THAILAND

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From longterm climatological data at Surat Thani, on the east coast of Southern Thailand, it has been shown that the climate there has been changed. In late November 1988, the catastrophic flood ever occurred in southern Thailand and in early November 1989, Typhoon Gay passed southern Thailand. These disasters caused environmental and coastal resources changes.

EFFECT OF THE KUROSHIO AND WINTER MONSOON ON THE OFFSHORE/ONSHORE TRANSPORT OF FISH LARVAE

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Japanese southern coast is composed of a chain of semicircular bays exposed to the Kuroshio. Temporal variations in the coastal circulations and water exchange associated with interaction of the Kuroshia and its coastal boundary geometrical were investigated based on the field observations by using moored current meters, satellite thermal images, ferry boats and research vessels.

Short term fluctuations in the Kuroshio front due to the frontal waves and smaller scale meander of the Kuroshio path, with the period of 5-10, 20-30 and 80-100 days, are superposed on the qusi- stationary large meandered path or non-large meandered path of the Kuroshio. These short and mid term onshore/offshore shift of the front and the path of the Kuroshio have significant effect on the fluctuations in the coastal circulations, of which one revolution is around one week or so.

While in the decadal time scale the mean circulation patterns of the coastal counter current along the coast of Japan are mainly affected by both of the path of the Kuroshio with/ without large meander and the offshore drift current due to the winter monsoon. The year to year variations in this offshore transport of the larvae have significant effect an the recruitment of the pelagic fish which spawns in the coastal boundary regions of the Kuroshio in winter season. In particular, during winter in 1972 and 1973, the Kuroshio flowed straightly along the coast and the winter monsoon was fairly weak, which might cause good retention of sardine's larvae in Tosa Bay off Shikoku and also in the downstream nursery ground, which might become a trigger of the rapid increase of the Sardine's stock in the early 1970s.

PLANKTON AS A BIOLOGICAL BARRIER ON A WAY OF TRACE METALS MIGRATION DURING ESTUARINE MIXING

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3 role of biological barrier in the migration of trace metals through the river-sea systemis increased during phytoplankton outbreak. We investigated biogeochemical parameters of the environment in marine pdrt of the Razdolnaya River-Amurskiy Bay (Sea of Japan) estuary during red tide in October 1987.

It has been established that the red tide was caused by <MI>Chattonella<D> sp. (Raphidophycea). The phenomenon has resulted in mass fishes deaths and change of the water colour to darkbrown. The species density being 8 million cells/l and 3 biomass 7 g/m^3.

The maximal densities (up to 15 million cells/l) and biomass (11 g/m^3) were recorded near water surface. Red tide was observed during fall "bloom" of phytoplankton, which annually registered in shallow waters of the north-western Sea of Japan in this season. Among 25 micrcalgae accompanying the red tide, dinoflagellates and diatoms were dominant. Peak of phytoplankton blooming was observed at t 14°C and S 28-29 ‰.

During our observations the concentrations of Zn and Pb in seston has good correlation with a level of primary productivity (PP). The additional study of TM in selected zooplankton groups from zone of maximal PP showed that the most capacious TM accumulator proved to be the hitinoconyaining plankters, especially those without secretory system or not enough developed. Chaetognatha accumulated more Pb than another TM. Contents of Pb in Chaetognatha was more than in hitinocontaining Euphausiidae and Copepoda nauplii, however the adult copepoda had the concentration of Pb higher than Chaetognathai Bivalvia larvae revealed a more high ability to accumulate Cd, Ni in comparison with Euphausiidae. The recent data shows that the accumulation of TM can be caused not only by hitin content but may depend also on other zooplankton species characteristics.

Presumably, the least TM content in young fishes of plankton is due to lack of hitin and their highly-developed secretoring system.

GIANT CLAM MARICULTURE

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Giant clams have been heavily exploited throughout their tropical Indo-Pacific distribution. Recently, research has been focussed on developing mariculture methods for giant clams to supplied the demand for their products and to re-populate depleted reefs. An international collaborative project has been underway since 1984 with funding from the Australian Center for International Agricultural Research. James Cook University is the commissioned Organisation and in the most recent phase has been collaborating with the Australian Institute of Marine Sciences, Queensland Department of Primary Industry, two universities in the Philippines and fisheries section of five South Pacific countries. The

project has developed appropriate technology for South Pacific country for culturing all phases of the giant clam life cycle.

DEVELOPING MARINE SCIENCES MATERIALS FOR SOUTH PACIFIC SCHOOLS

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Responding to the requests from South Pacific for relevant and appropriate school resources in marine science, educators and scientists from James Cook University are working collaboratively to produce six units for upper secondary school students. The chief goal of this UNESCO funded project is to contribute to improvement of marine science education in secondary schools of the South Pacific Region.

The strength of the development process for this project is that the design of the materials has been based on the needs of both teachers and students in the region. As, well, a trial of three prototype units will be conducted in several schools in three Pacific countries further enhancing the likelihood for adoption of the materials.

Writing of the first three units (viz. Coral reefs, Coral Islands and Sandy Beaches) is in progress. These units will be evaluated during the trial, early in 1992.

This paper not only overviews the project design, but also reports on the initial needs assessment and writing process. As well, selected samples of text are displayed to illustrate important design features of the units.

A TURF ALGAL FLORA OF THE GREAT BARRIER REEF

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A comprehensive Flora of the turf-forming red algae of the Great Barrier Reef is press the publication provides descriptions illustrations of the species recorded with emphasis on vegetative features. In addition, data on nomenclature, type material, voucher specimens, habitat, seasonality and geographical distribution are given. Genus descriptions keys to genera and species, and a glossary are also included. This is the first detailed treatment of the taxonomy and distribution of the turf algae which occur on coral reefs, where they are of major importance in trophodynamics.

A NUMERICAL WAVE PREDICTION MODEL FOR THE JAPAN SEA

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This work is concerned to a operational numerical wave prediction model for the Japan Sea. This model of Dp type is based on the wave spectral energy-balance equation. The model was tested under some wind conditions, and is in the application at the Central Weather forecasting Center of HMS.

This model is similar to the Isozaki's (1972) model in its form, but linear and exponential growth coefficients A and B are not same as that of Inoue (1967). That is, we use the coefficients of Barnett model. (Barnett, 1968)

This model is Dp type model, in which each wave cell or component propagates at its appropriate group velocity along its own ray path.

For the purpose of experiments with the model, calculation of wave fields was carried out over the grid area of the Japan sea. In order to estimate the behaviour of the model presented above the significant wave heights, H, and periods at each points over the grid area were calculated under various wind conditions.

Although these wind conditions are artificial, but such wind fields may be considered as possible one over oceans and seas, and with such artificial wind conditions we can estimate the behaviour of our model. Then we are also able to compare to a well known results or diagrams on wave characteristics.

For these purpose, we can use the Manual Wave-Forecasting Diagram. (WMO, 1988: Guide to Wave Analysis and Forecasting, WMO- No. 3-30) In the growth stages the model curves agree reasonably well with these those of the diagram, Also, a another comparison was presented in this paper.

In addition to these, all the results from various wind conditions are shown that the model gives very satisfactory results over the Japan sea.

This wave model started to run from october 1990, using wind data from output of Numerical Weather Forecast Model of the Central Weather Forecasting Institute of HMS. The surface winds over the sea are estimated by a model for calculating surface winds from pressure field, surface air and sea surface temperature, which was proposed by Cardon (1969).

Systematic verification of this model are made operationally using visual wave observation from ships. For example, Fig. 3 is a wave forecast field for 09-31-march of 1991.

Wave modelling is a technique for objective wave analysis and forecasting, and must be based on good understanding of wave phenomena and analysing of reliable wave observations or measurements. In the next steps, we would like to improve our model by considering wave-wave interaction and coastal transform.

THE EFFECTS OF MOUNTAIN MASSIF AND SEA ON THE FORMATION OF THE OKHOTSK HIGH

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Korea is a peninsula located at east side of Eurasian continent. So when we study about atmospheric phenomena and climate character of Korea, we have to consider the influence of the sea on them as well as of the continent.

Okhotsk High that occurs on the Okhotsk Sea in summer is also formed by both effects of sea and land it exists with rather long duration.

As Okhotsk High is formed and it extends to the north part of Korea East Sea (Japanese Sea) by the cold sea water, cold and wet marine air mass is transported there along the south edge of the High and thus, cool summer damage occurs in north part of the east coastal region of Korea.

To realize mechanism of formation of Okhotsk High has an important significance in understanding basic process of cool summer damage and other climatic properties of Korea.

In order to realize the mechanism, we have some statistical consideration and numerical experiments.

With the view of carrying out the numerical experiment on a microcomputer, a 3 layers spectral primitive equation model in the rectangular domain is developed, which is though simple enough for practical application, yet has capability of responding effectively to the external thermal and dynamical forcing due to land and sea.

The results that we get from statistical consideration and numerical experiments are as follows:

i) The atmospheric planetary waves occur by dynamical effect of Tibetan plateau, Rockies and another massif. As the result, the ridge which reaches to high level is formed around Okhotsk Sea in summer.

The location of Jet stream and the intensity of westerly are change seasonaly, which makes the dynamical effect of the massif vary. Therefore Okhotsk High has seasonal character,

ii) One of the important character of Okhotsk Sea is that sea water is colder than another sea at the same latitude.

Thus this cold water affects to formation of Okhotsk High as thermal sink. The low level high is formed by this effect, but the effect can't make high level one.

But if Low level high due to thermal sink is connected with upper ridge or high that occurs by dynamical effect which have been stated above, tall and lasting Okhotsk High is formed.

NUMERICAL SIMULATION OF OCEAN VARIABILITIES AND EXTRASEASONAL PREDICTION OF CLIMATE ANOMALIES

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1. Introduction to some OGCMs

Recent years in China, some OGCMs have been developed. The rigid-lid approximation is removed, the standard stratification is subtracted, and the departures of variables are computed.

2. Numerical simulations of oceanic circulations and their variabilities

Emphases are made on the numerical simulations of (a) large scale circulations of World Oceans and Pacific Ocean, (b) mesoscale circulations of West Pacific and South China Sea, and (c) El Niño and Laniña events.

3. Experiments of extraseasonal prediction of climate anomalies by using CGCM

Two cases are examined. One is the prediction of the decaying of 1989 LANINA event and its influence on monsoon rainfall, the other is the prediction of 1991 summer drought and flood in China.

No.	Title	Languages
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) in the 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
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, 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 1991	E
75	IOC-SCOR Workshop on Global Ocean Ecosystem Dynamics. Solomons, Maryland, USA. 29 April - 2 May 1991	E